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Related Publications

CP150/CP200 Basic Service Manual 6880309N61
CP150/CP200 User Guide 6880309N60

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Chapter 1 Test Equipment, Service Aids, and Service Tools

1.1 Test Equipment

Table 1-1 lists test equipment required to service the CP150/CP200 Radios.

Table 1-1. Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2600 series	System analyzer	This item will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1074A	Fluke 87 digital multimeter	True RMS metering, 200 kHz frequency counter, 32-segment bar graph with backlit display	Digital voltmeter is recommended for AC/DC voltage and current measurements
	Fluke 85 RF probe	500 MHz, 30 VAC max	Use with Fluke 87 digital multimeter for RF voltage measurements.
*R1377A	AC voltmeter	1 mV to 300 mV, 10 megaohm input impedance	Audio voltage measurements
R1611A	Dual channel 100 MHz oscilloscope (Agillent)	Two-channel, 100 MHz bandwidth, 200 M sample rate/sec, 2 MB memory/channel	Waveform measurements
S1339A	RF millivolt meter	100 µV to 3V RF, 10 kHz to 1 GHz frequency range	RF level measurements
*R1013B or *R1370A	SINAD meter or SINAD meter with RMS	Without RMS audio voltmeter or With RMS audio voltmeter	Receiver sensitivity measurements

1.2 Service Aids

Table 1-2 lists service aids recommended for working on the CP150/CP200 Radios. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 1-2. Service Aids

Motorola Part No.	Description	Application
RLN4460	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
RLN4510	Battery Interface	Regulates DC current and voltage between radio and power supply.
RVN4191	Customer Programming Software and Global Tuner Software on CD Rom	Program customer option and channel data.
AAPMKN4004	Programming Test Cable	Connects radio to RIB (PLN4008).
AAPMKN4003	Radio-to-Radio Cloning Cable	Allows a radio to be duplicated from a master radio by transferring programmed data from the master radio to the other.
RLN4008	Radio Interface Box	Enables communications between the radio and the computer's serial communications adapter.
5886564Z01	RF Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
0180305K08	Shop Battery Eliminator	Interconnects radio to power supply.
HSN9412	Wall-Mounted Power Supply	Used to supply power to the RIB (120 VAC).
3080369B71 or 3080369B72	Computer Interface Cable	Use B72 for the IBM PC AT or newer (9-pin serial port). Use B71 for older models (25-pin serial port). Connects the computer's serial communications adapter to the RIB (PLN4008).
6686533Z01	Knob Remover/Chassis Opener	Used to remove the front cover assembly.
HKN9216	IBM Computer Interface Cable	Connection from computer to RIB.
8180384N65	Housing Eliminator	Allows testing of the radio outside of the housing.

Table 1-3. Recommended Service Tools

Motorola Part No.	Description	Application
RSX4043A	TORX screwdriver	Tighten and remove chassis screws
6680387A70	T6 TORX bit	Removable TORX screwdriver bit
R1453A	Digital readout solder station	Digitally controlled soldering iron
RLN4062A	Hot air workstation, 120 V	Tool for hot air soldering/desoldering of surface mounted integrated circuits

Table 1-3. Recommended Service Tools (Continued)

Motorola Part No.	Description	Application
0180386A78	Illuminated magnifying glass with lens attachment	Illumination and magnification of components
0180302E51	Master lens system	
0180386A82	Anti-static grounding kit	Used during all radio assembly and disassembly procedures
6684253C72	Straight prober	
6680384A98	Brush	
1010041A86	Solder (RMA type), 63/67, 0.5mm diameter, 1 lb. spool	
0180303E45	SMD tool kit (included with R1319A)	
R1319A	ChipMaster (110 V)	Surface mount removal and assembly of surface mounted integrated circuits and/or rework station shields. Includes 5 nozzles.
R1321A	ChipMaster (220 V)	
ChipMaster Nozzles:		
6680332E83	PLCC-28* nozzle	Soldering and Un-soldering IC's
6680332E82	PLCC-44* nozzle	
6680332E94	PLCC-52 nozzle	
6680332E96	PLCC-84 nozzle	
6680334E67	QFP-160 nozzle	
6680333E46	SOL-18 nozzle	
6680332E84	SOIC-20 nozzle	
6680332E87	SOL-20J nozzle	
6680333E45	SOL-24 nozzle	
6680333E55	TSOP-64 nozzle	

* Included with ChipMaster packages

Programming/Test Cable

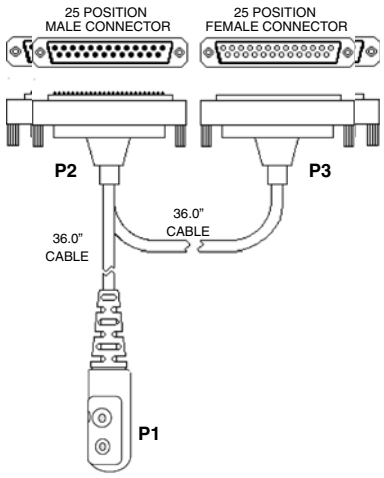


Figure 1-1. Programming/Test Cable

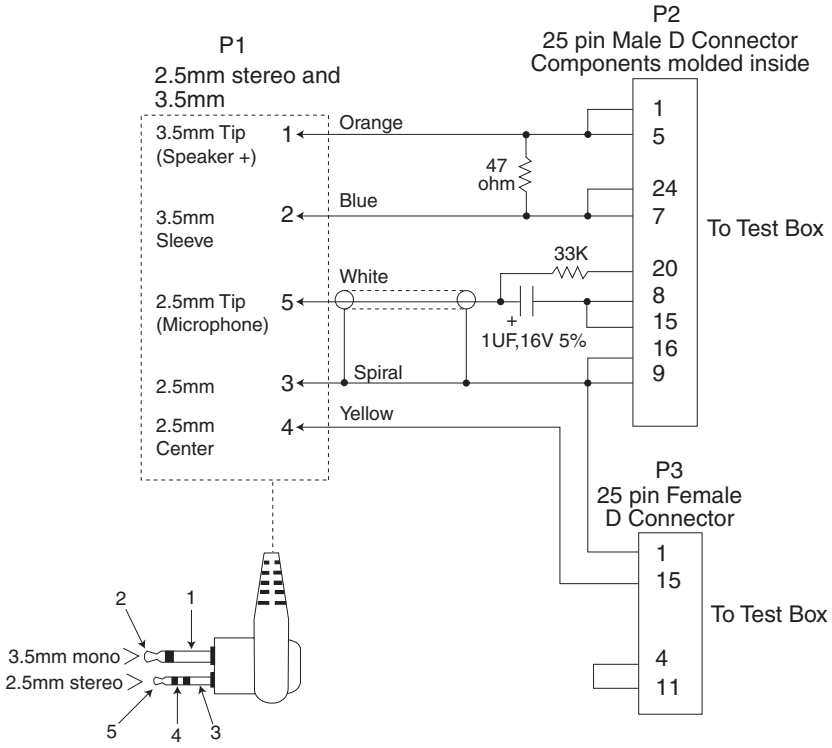


Figure 1-2. Wiring of the Connectors

Chapter 2 DC Power Distribution

2.1 DC Regulation and Distribution

A block diagram of the DC power distribution throughout the radio is shown in Figure 2-1.

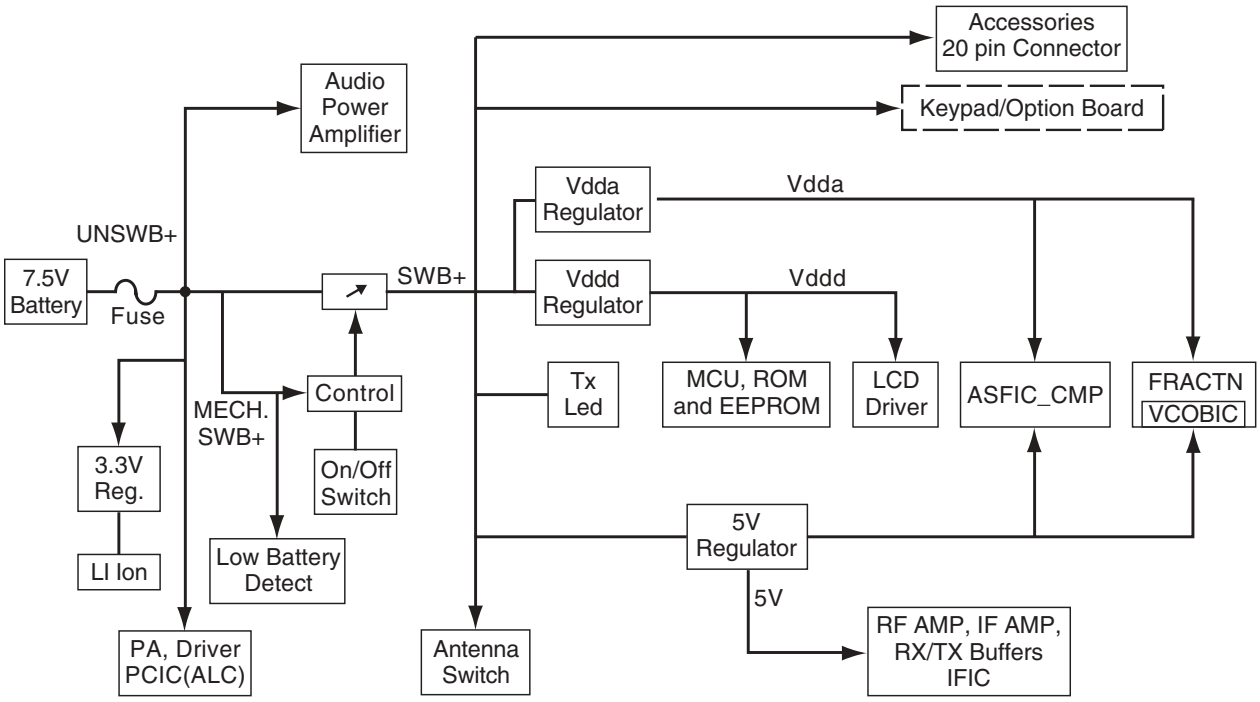


Figure 2-1. DC Power Distribution Block Diagram

Battery voltage enters at connector J301 and is routed through fuse F301 to become USWB+. VR301 protects against ESD, and D301 provides reverse polarity protection. This voltage is routed to:

- FET switch Q170 in the TX power control circuit (turned on during transmit)
- TX power amplifier module U110 (via R150)
- input pins of regulators U310, U320 and U330
- FET switch Q493 (turned on whenever the radio is on)
- on-off switch S444 (part of on-off-volume control) to become SWB+

When the radio is turned on, SWB+ is present and is applied to:

- transistor switch Q494 (pins 1 and 6) which turns on Q493
- RX audio power amplifier U490
- voltage divider R420/R421 and port PE0, a microprocessor A/D input which measures battery voltage and radio on/off status

The output of FET switch Q493 is applied to the control pins of regulators U310, U320 and U330, turning them on. The following regulators are used:

Table 2-1. Voltage Regulators

Reference No.	Description	Type
U310	5 V Regulator	TK71750S
U320	Digital 3.3 V Regulator	LP2986
U330	3 V Regulator	TK71730S

The 5 V source is applied to:

- RX back end circuitry
- synthesizer super filter input and charge pump supply
- RED/GRN LEDs
- RX audio buffer U510
- portions of ASFIC U451

The 5 V source is also applied to FET switches Q311 and Q312. Q311 is turned on by Q313 when RX_ENA (from U401 pin 49) is high, and supplies the "5R" source to the RF front end stages Q21-Q22, and the VCO RX injection buffer Q280. Q312 is turned on by Q313 when TX_ENA (from U401 pin 50) is high, and supplies the "5T" source to the first transmitter stage Q100.

The digital 3.3 volt source from U320 (D_3.3 V) is applied to:

- microprocessor U401
- EEPROM U402
- flash ROM U404

The 3 V regulated source from U330 is applied to:

- synthesizer IC U201
- VCO/buffer IC U251
- portions of ASFIC U451
- microphone bias circuitry

While the radio is turned on, port PH3 (U401 pin 44) is held high. When the radio is turned off, SWB+ is removed and port PE0 (U401 pin 67) goes low, initiating a power-down routine. Port PH3 (pin 44) remains high, keeping the voltage regulators on via Q493 and Q494, until the operating state of the radio has been stored in EEPROM and other turn-off data functions have been completed. PH3 then goes low, turning off Q494 and Q493, and all regulated voltages are removed.

Chapter 3 Controller Theory of Operation

3.1 Controller

The controller provides the following functions:

- interface with controls and indicators
- serial bus control of major radio circuit blocks
- encoding and/or decoding of selective signaling formats such as PL, DPL, MDC1200 and Quik-Call II
- interface to CPS programming via the microphone connector
- storage of customer-specific information such as channel frequencies, scan lists, and signaling codes
- storage of factory tuning parameters such as transmitter power and deviation, receiver squelch sensitivity, and audio level adjustments
- power-up, power-down and reset routines

Figure 7-3 (VHF) shows the interconnection between the controller and the various other radio blocks. Figure 7-9 show the connections between the following circuit areas which comprise the controller block:

- microprocessor circuitry
- audio circuitry
- DC regulation circuitry (refer to Chapter 2, DC Regulations and Distribution.)
- rotary and pushbutton controls and switches
- option board interface

The majority of the circuitry described below is contained in the (VHF) Microprocessor Circuitry schematic diagrams (Figure 7-10). Portions are also found in the Audio and DC Regulation schematics (Figures 7-11 and 7-12).

3.1.1 Microprocessor Circuitry

The microprocessor circuitry includes microprocessor (U401) and associated EEPROM, S-RAM (not used in PR400 models), and Flash ROM memories. The following memory IC's are used:

Table 3-1. Radio Memory Requirements

Reference No.	Description	Type	Size
U402	Serial EEPROM	AT25128	16K x 8
U403	Static RAM	(not used)	
U404	Flash ROM	AT49LV001N_70 V	128K x 8

3.1.1.1 Memory Usage

Radio operation is controlled by software that is stored in external Flash ROM memory (U404). Radio parameters and customer specific information is stored in external EEPROM (U402). The operating status of the radio is maintained in RAM located within the microprocessor. When the radio is turned off, the operating status of the radio is written to EEPROM before operating voltage is removed from the microprocessor. See section "3.1.1.7 Microprocessor Power-Up, Power-Down and Reset Routine" on page 3-3 for a discussion of the power-down routine.

Parallel communication with U403 and U404 is via:

- address lines A(0)-A(16), from U401 port F ADDR0-ADDR13 and port G XA14-XA16
- data lines D(0)-D(7), from U401 port C DATA0-DATA7
- chip-select for U403, from PH6 (U401 pin 41)
- chip-enable for U404, from PH7 (U401 pin 38)
- output enable for U404, from PA7 (U401 pin 86)
- write-enable for both U403 and U404, from PG7_R/W (U401 pin 4)

Serial communication with U402 is via:

- the SPI bus (see section "3.1.1.3 Serial Bus Control of Circuit Blocks" on page 3-2)
- chip-select for U402, from PD6 (U401 pin 3)

3.1.1.2 Control and Indicator Interface

Ports PI3 and PI4 are outputs which control the top-mounted LED indicator. When PI3 is high, the indicator is red. When PI4 is high, the indicator is green. When both are high, the indicator is amber. When both are low, the indicator is off.

Pressing the side-mounted PTT button (S441) provides a low to port PJ0 (U401 pin 71), which indicates PTT is asserted. Side-mounted option buttons 1 and 2 (S442 and S443) are connected to Ports PJ6 (pin 77) and PJ7 (pin 78), respectively.

3.1.1.3 Serial Bus Control of Circuit Blocks

The microprocessor communicates with other circuit blocks via a SPI (serial peripheral interface) bus using ports PD2 (data into uP), PD3 (data out of uP) and PD4 (clock). The signal names and microprocessor ports are defined in Table 3-2.

Table 3-2. SPI Bus Signal Definitions

Signal Name	Microprocessor Port	Microprocessor Pin
SPI-DATA_IN	PD2-MISO	U401 Pin 99
SPI_DATA_OUT	PD3-MOSI	U401 pin 100
SPI_CLK	PD4-SCK	U401 pin 1

These signals are routed to:

- the audio filter IC (U451) to control internal functions such as gain change between 25 kHz and 12.5 kHz channels, transmit or receive mode, volume adjustment, etc.
- the synthesizer IC U201 to load receive and transmit channel frequencies
- option board connector J460-1 for internal option configuration and control
- serial EEPROM U402 (both SPI_DATA_IN and SPI_DATA_OUT are used).

In order for each circuit block to respond only to the data intended for it, each peripheral has its own chip select (or chip enable) line. The device will only respond to data when its enable line is pulled low by one of the microprocessor ports, as follows:

- port PD5 (U401 pin 2) for the audio filter IC
- port PH0 (U401 pin 47) for the synthesizer IC
- port PD6 (U401 pin 3) for the serial EEPROM.

3.1.1.4 Interface to RSS Programming

The radio can be programmed, or the programmed information can be read, using a computer with CPS (Customer Programming Software) connected to the radio via a RIB (radio interface box) or with the RIB-less cable. Connection to the radio is made via the microphone connector (part of accessory connector J471). The SCI line connects the programming contact (J471 pin 6) to ports PD0_RXD (data into uP, pin 97) and PD1_TXD (data out of uP, pin 98). Transistor Q410 isolates the input and output functions by allowing PD1 to pull the line low, but does not affect incoming data from being read by port PD0. This isolation allows high-speed 2-wire programming via TP401 and TP402 for factory programming and tuning.

3.1.1.5 Storage of Customer-Specific Information

Information that has been programmed using CPS, such as channel frequencies or selective signaling codes, are stored in the external EEPROM, where it is retained permanently (unless reprogrammed) without needing DC power applied to the microprocessor.

3.1.1.6 Sensing of Externally-Connected Accessories

Port PJ1 is used to detect the presence of externally connected accessories. Port PJ1 (U401 pin 72) is normally low, unless accessories (lapel speaker microphone, lightweight headset, etc.) are used with the radio. This port is used to detect an accessory PTT or auto sensing of a VOX accessory.

If VOX is programmed into the radio channel codeplug information, and PJ1 is high during power-up, the radio will activate VOX operation. If a low is present at port PJ1 during power-up, the radio will use this port as an external PTT indicator.

3.1.1.7 Microprocessor Power-Up, Power-Down and Reset Routine

On power-up, the microprocessor is held in reset until the digital 3.3 V regulator (U320 pin 5) provides a stable supply voltage. Once the digital supply reaches steady state and releases the reset line (U320 pin 7), the microprocessor begins to start up. The ASFIC_CMP (U451) has already started running and is providing the startup clock to the microprocessor. After reset release by all circuits, the software within the microprocessor begins executing port assignments, RAM checking, and initialization. A fixed delay of 100 ms is added to allow the audio circuitry to settle. Next, an alert beep is generated and the steady state software begins to execute (buttons are read, radio circuits are controlled).

When the radio is turned off, SWB+ is removed and port PE0 (U401 pin 67) goes low, initiating a power-down routine. Port PH3 (pin 44) remains high, keeping the voltage regulators on via Q493 and Q494, until the operating state of the radio has been stored in EEPROM. PH3 then goes low, and all regulated voltages are removed.

The microprocessor reset line (pin 94) can be controlled directly by the digital 3.3 V regulator (U320 pin 7), the microphone jack (part of accessory connector J471) via Q472 and Q471, and the microprocessor itself. U320 pulls the reset line low if the digital 3.3 V source loses regulation. This prevents possible MOS latch-up or overwriting of registers in the microprocessor because the reset line is higher in voltage than the microprocessor VDD ports (U401 pins 12, 39, 59, 88). The microprocessor can drive the reset line low if it detects a fault condition such as an expired watchdog timer, software attempting to execute an infinite loop, unplanned hardware inputs, static discharge, etc. Finally, the Q471 can pull the reset line low during use of the programming cable and CPS by the application of a sufficiently negative voltage to the microphone connector tip contact (J471 pin 4), however this reset method is not utilized.

3.1.1.8 Boot Mode Control

When power-up reset occurs, the microprocessor will boot into either normal or flash mode depending on the logic level of ports MODA (U401 pin 58) and MODB (pin 57). The Flash Adapter is a programming accessory which provides negative 9 volts dc via a 1K resistor to microphone connector J471 pin 4. This turns on Q471 and Q472 via D471 and VR472, pulling MODA and MODB low and allowing booting in the flash mode by cycling power to reset the radio. Software upgrades can then performed by loading the new software code into Flash ROM U404.

3.1.1.9 Microprocessor 7.3975 MHz Clock

The 7.3975 MHz clock signal (uP_CLK) is provided from the ASFIC_CMP (U451 pin 28). Upon startup the 16.8MHz crystal provides the signal to the ASFIC_CMP, which sends out the uP_CLK at 3.8MHz until a steady-state condition is reached and the clock is increased to 7.3975MHz for the microprocessor.

3.1.1.10 Battery Gauge

Various battery types are available having different capacities. The different battery types contain internal resistors connected from the BATT_CHARGE contact to ground (which is routed to the microprocessor as BATT_DETECT). A voltage divider is formed with R255 producing a different DC voltage for each battery type, which is read by microprocessor port PE2 (pin 65). This allows the software to recognize the battery chemistry being used and adjust the battery gauge for best accuracy.

3.1.2 Audio Circuitry

3.1.2.1 Transmit and Receive Low-Level Audio Circuitry

The majority of RX and TX audio processing is performed by U451, the Audio Filter IC (ASFIC_CMP), which provides the following functions:

- Tone PL/Digital PL encode and decode filtering
- Tone PL/Digital PL rejection filter in RX audio path
- TX pre-emphasis amplifier
- TX audio modulation limiter
- Post-limiter (splatter) filter
- TX deviation adjust (digitally-controlled attenuators)
- Programmable microphone gain attenuator
- RX audio volume control (digitally controlled attenuator)
- Carrier squelch adjustment (digitally controlled attenuator)
- Microprocessor output port expansion

- 2.5 volt dc reference source
- Microprocessor clock generation (from the 16.8 MHz reference oscillator input)

The parameters of U451 that are programmable are selected by the microprocessor via the CLOCK (U451 pin 21), DATA (U451 pin 22) and chip enable (U451 pin 20) lines.

RX audio buffer U510 amplifies the audio level from the DEMOD output of the IFIC before being applied to the audio filter IC input (DISC, U451 pin 2). The buffer is DC coupled to avoid corruption of low-frequency data waveforms such as DPL. Because such waveforms are polarity sensitive, this buffer is configured as a single-stage inverting amplifier (U510-1 only) for VHF models where high-side first injection is used, or is configured as a two-stage non-inverting amplifier (U510-1 and -2) for UHF models using low-side first injection. The gain of the buffer is 1.5 times or 3.5 dB.

U480 and associated components are not used. Stage U480-1 is bypassed by jumper R487.

Volume adjustment is performed by a digital attenuator within U451. The volume control (10KO, part of S444) is connected to D_3.3 V and ground via R506 and R507. When the volume control is rotated, it varies the dc voltage applied to microprocessor A/D input port PE1 (U401 pin 66) between approximately 0 volts dc at minimum volume to 3.3 volts dc at maximum volume. Depending on this voltage, the appropriate setting of the digital volume attenuator is selected. This technique is less susceptible to noise than a conventional analog volume control.

3.1.2.2 Audio Power Amplifier

The audio power amplifier IC U490 amplifies receiver audio from U451 pin 41 to a level sufficient to drive a loudspeaker. U490 is a bridge amplifier delivering 3.46 volts rms between pins 5 and 8 without distortion, which is sufficient to develop 500 milliwatts of audio power into the internal 24 ohm speaker or an external 24 ohm load. The audio power amplifier is muted whenever speaker audio is not required to reduce current drain. The audio amp is muted when U451 pin 14 is low. When U451 pin 14 is high, U490 pin 1 is pulled low by Q490, enabling the audio amplifier.

Because the power amplifier is a bridge-type, neither speaker terminal is grounded. Care should be taken that any test equipment used to measure the speaker audio voltage does not ground either speaker output terminal, otherwise damage to the audio power amplifier IC may result. When a 24-ohm load resistor is used it should be connected between the tip and the sleeve of accessory jack J471 (3.5mm port), never to ground. External SPKR plug insertion mechanically disconnects the internal speaker. Voltage measurements using test equipment that is not isolated from ground may be made from one side of the speaker or load resistor (either the tip or the sleeve of J471) to chassis ground, in which case the voltage indicated will be one half of the voltage applied to the speaker or load resistor. The Motorola RLN4460 Portable Test Set and AAPMKN4004 Programming Test Cable provide the proper interface between the radio's ungrounded audio output and ground-referenced test equipment.

3.1.2.3 Internal Microphone Audio Voice Path

Microphone audio from internal microphone is routed from J470-1 via C475, L471, and C470 to the ASFIC_CMP mic audio input (MICINT, U451 pin 46). During transmit, Q470 is turned on by a low at U451 pin 35, providing dc bias for the internal MIC via R478. External MIC plug insertion mechanically disconnects the internal microphone. External MIC audio is coupled through L471 and C470 to the mic audio input. An input level of 10 mV at J471 pin 4 produces 200 mV at the output of U451 pin 40, which corresponds to 60% deviation.

3.1.2.4 PTT Circuits

The internal side-mounted PTT switch (S441) is sensed directly by microprocessor port PJ0 (U401 pin 71). External mic PTT is sensed by measuring the current drawn through the accessory connector (J471-4) by the mic cartridge (which is in series with the accessory PTT switch). This current is drawn through the base (pin 5) and emitter (pin 4) of a transistor in Q470, causing its collector (pin 3) to supply a logic-high to microprocessor port PJ1 (pin 72).

3.1.2.5 VOX Operation

VOX audio accessories do not have a PTT switch. Instead, the mic cartridge is wired directly from J471-4 to ground. If the radio has been programmed for VOX operation and the VOX accessory is plugged in prior to turning the radio on, the current drawn by the cartridge will turn on Q470 (pins 3-4-5) and a logic high will be seen at port PJ1 at turn-on. The microprocessor then assumes VOX operation, with PTT controlled by the presence of audio at the mic cartridge. A dc voltage proportional to the audio level at the input of the ASFIC_CMP (U451 pin 46) is fed to an A/D input of microprocessor U401 (pin 62). During VOX operation, PTT is activated when the dc level exceeds a preset threshold.

3.1.2.6 Battery Charging Through Microphone Jack

A wall-type charging power supply may be connected to the 2.5 mm microphone jack (part of accessory connector J451). The voltage present at the tip contact (pin 4) is applied to the center charging contact of the battery via diode D470. Another diode, internal to the battery, applies this voltage to the (+) battery terminal. Only the recommended charger and battery type should be charged in this manner.

Different battery types contain internal resistors connected from the BATT_CHARGE contact to ground, which is routed to the microprocessor as BATT_DETECT. A voltage divider is formed with R255 producing a DC voltage which is read by microprocessor port PE2 (pin 65). This allows the software to recognize the battery chemistry being used and adjust the battery gauge for best accuracy. The value of R255 is chosen so that the voltage at the BATT_CHARGE node (cathode of D470) is never low enough to turn on the EXT_MIC_PTT sense transistor (part of Q470).

3.1.2.7 Programming and Flashing Through Microphone Jack

The ring contact on the 2.5 mm microphone jack is used for reading, programming or re-flashing the radio using CPS. This contact (J471 pin 6) is routed to ports PD0_RXD (data into uP, pin 97) and PD1_TXD (data out of uP, pin 98). Transistor Q410 isolates the input and output functions by allowing PD1 to pull the line low, but does not affect incoming data from being read by port PD0.

To re-flash the radio (overwrite the software in the Flash ROM with new software), the radio must power up in the boot mode. This is accomplished by using a flash adapter accessory, which provides SCI communication with the programming ring contact (J471 pin 6) and also allows a negative voltage (negative 9 volts dc via a 1K resistor) to be applied to the tip contact (J471 pin 4). This voltage is sufficient to turn on the base-emitter junction (pins 1 and 2) of Q472 via L471, D471, VR472 and R471. Pin 6 of Q472 goes high, turning on Q471 (pins 3 and 4) and pulling the BOOT_ENA line (ports MODA and MODB of the microprocessor) low. Cycling power generates a reset which causes the radio to boot in the flash mode.

Chapter 4 136-162 MHz VHF Theory Of Operation

4.1 Introduction

This chapter provides a detailed theory of operation for the radio components. Schematic diagrams for the circuits described in the following paragraphs are located in Chapter 7 of this manual.

4.2 VHF Receiver

The VHF receiver covers the range of 136-162 MHz and provides switchable IF bandwidth for use with 12.5 kHz or 20/25 kHz channel spacing systems. The receiver is divided into two major blocks as shown in Figure 4-1.

- Front End
- Back End

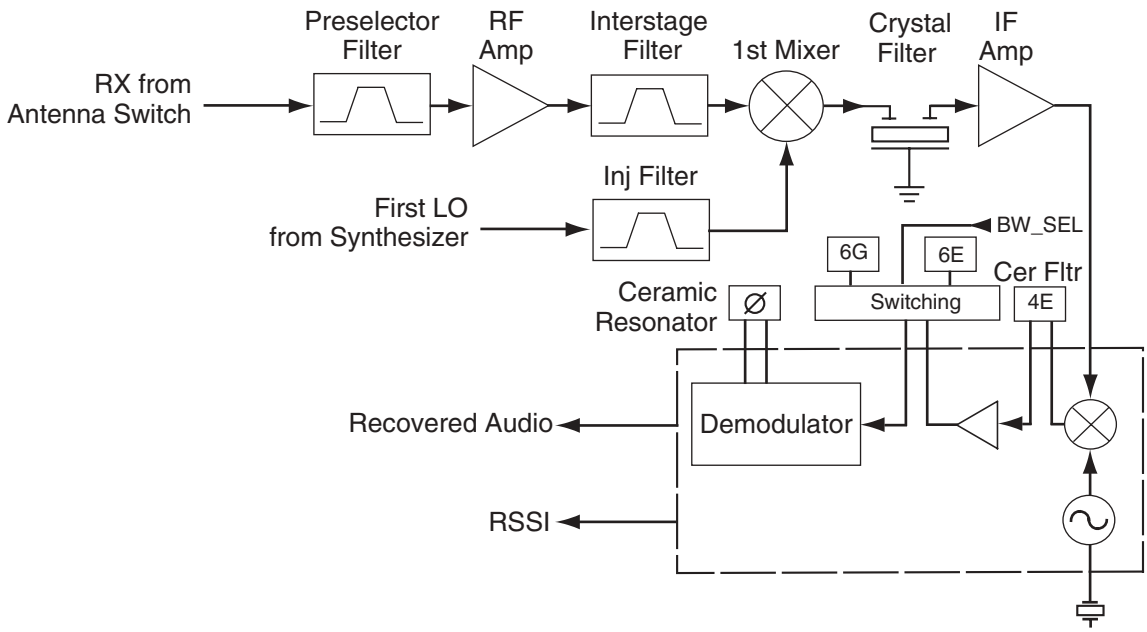


Figure 4-1. VHF Receiver Block Diagram

4.2.1 Receiver Front-End

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, an interstage filter, and a double-balanced first mixer.

The preselector filter is a fixed-tuned 4-pole design using discrete elements (L1-L4 and C1-C9) in a series/shunt resonator configuration. It has a 3 dB bandwidth of 43 MHz, an insertion loss of 2 dB and image attenuation of 37 dB at 226 MHz, with increasing attenuation at higher frequencies. Diode CR1 protects the RF amplifier by limiting excessive RF levels.

The output of the filter is matched to the base of RF amplifier Q21, which provides 18 dB of gain and a noise figure of 2 dB. Operating voltage is obtained from the 5R source, which is turned off during transmit to reduce dissipation in Q21. Current mirror Q22 maintains the operating current of Q21

constant at 6.2 mA regardless of device and temperature variations, for optimum dynamic range and noise figure.

The output of the RF amplifier is applied to the interstage filter, a fixed-tuned 3-pole series-coupled resonator design having a 3 dB bandwidth of 54 MHz and insertion loss of 1.8 dB. This filter has an image rejection of 40 dB at 226 MHz, with increasing attenuation at higher frequencies.

The output of the interstage filter is connected to the passive double-balanced mixer consisting of components T41, T42, and CR41. This mixer has a conversion loss of 7 dB. High-side injection from the frequency synthesizer is filtered by L40-L41 and C40-C44 to remove second harmonic energy that may degrade half-IF spurious rejection performance. The injection filter has a 3 dB bandwidth of 52 MHz and an insertion loss of 1.5 dB. The filtered injection signal is applied to T42 at a level of +6 dBm.

The mixer output is applied to a diplexer network (L51-L52, C51, R51) which matches the 44.85 MHz IF signal to crystal filter FL51, and terminates the mixer into 50Ω at all other frequencies

4.2.2 Receiver Back-End

The receiver back end is a dual conversion design. High IF selectivity is provided by FL51, a 4-pole fundamental mode 44.85 MHz crystal filter with a minimum 3 dB bandwidth of + 6.7 kHz, a maximum 20 dB bandwidth of ±12.5 kHz, and a maximum insertion loss of 3.5 dB. The output is matched to IF amplifier stage Q51 by L53 and C93. Q51 provides 16 dB of gain and a noise figure of 1.8 dB. The dc operating current is 1 mA. The output of Q51 is applied to the input of the receiver IFIC U51. Diode CR51 limits the maximum RF level applied to the IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio and RSSI op amps. The second LO frequency, 44.395 MHz, is determined by Y51. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters, FL52 (between the second mixer and IF amp) and FL53 or FL54 (between the IF amp and the limiter input). The wider filter FL53 is used for 20/25 kHz channel spacing, and the narrower filter FL54 is used for 12.5 kHz channels. When the BW_SEL line is high, the two upper diodes in packages D51 and D52 are forward biased, selecting FL53 for 20/25 kHz channels. When the BW_SEL line is low, the two lower diodes in packages D51 and D52 are forward biased, selecting FL54 for 12.5 kHz channels.

	FL52	FL53	FL54
Number of Elements:	4	6	6
Insertion Loss:	4 dB	4 dB	4 dB
6 dB Bandwidth:	15 kHz	15 kHz	9 kHz
50 dB Bandwidth:	30 kHz	30 kHz	22 kHz
Stopband Rejection:	27 dB	47 dB	47 dB

Ceramic resonator Y70 provides phase vs. frequency characteristic required by the quadrature detector, with 90 degree phase shift occurring at 455 kHz. Buffer Q70 provides a lower driving impedance from the limiter to the resonator, improving the IF waveform and lowering the distortion of the recovered audio signal. The recovered audio level at the DEMOD output is 120 mV rms (25 kHz channel, 3 kHz deviation) or 60 mV rms (12.5 kHz channel, 1.5 kHz deviation). An additional RSSI output provides a DC voltage level that is proportional to RF signal level. This voltage is measured by an A/D converter contained in the microprocessor (PE4_AN4, U401 pin 63).

4.3 VHF Transmitter

The VHF transmitter covers the range of 136-162 MHz. Depending on model, the output power of the transmitter is either switchable on a per-channel basis between high power (5 watts) and low power (1 watt), or is factory preset to 2 watts. The transmitter is divided into four major blocks as shown in Figure 4-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control

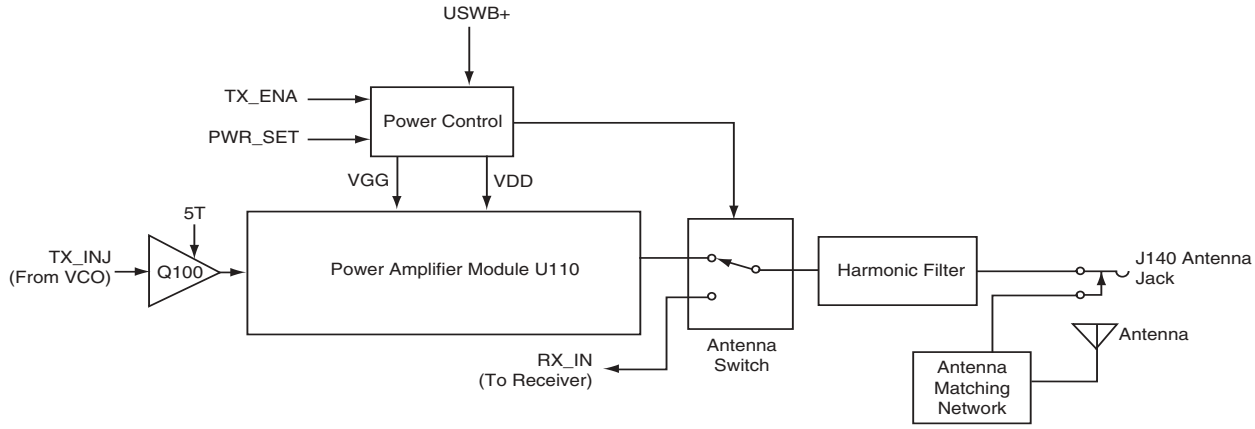


Figure 4-2. VHF Transmitter Block Diagram

4.3.1 Transmit Power Amplifier

The transmitter power amplifier has three stages of amplification. The first stage, Q100, operates in Class AB from the 5T source. It provides 13 dB of gain and an output of 20 mW. The current drain is typically 25mA. Components C105-C107 and L103 match the output of Q100 to the 50Ω input of the module U110.

U110 is a two stage Silicon MOS FET power amplifier module. Drain voltage is obtained from UNSW B+ after being routed through current-sense resistor R150 in the power control circuit. The output power of the module is controlled by varying the DC gate bias on U110 pin 2 (VGG).

4.3.2 Antenna Switch

The antenna switch consists of two pin diodes, D120 and D121. In the receive mode, both diodes are off. Signals applied at the antenna or at jack J140 are routed, via the harmonic filter, through network C122-C124 and L121, to the receiver input. In the transmit mode, Q170 is on and TXB+ is present, forward-biasing both diodes into conduction. The diode current is 50 mA, set by R120-R122. The transmitter RF from U110 is routed through D120, and via the harmonic filter to the antenna jack. D121 conducts, shunting RF power and preventing it from reaching the receiver. L121 is selected to appear as a 1/4 wave at VHF, so that the low impedance of D121 appears as a high impedance at the junction of D120 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

4.3.3 Harmonic Filter

The harmonic filter consists of components C130-C136 and L130-L132. The harmonic filter is a seven-pole elliptical low-pass configuration, optimized for low insertion loss, with a 3 dB frequency of approximately 180 MHz and typically less than 0.8 dB insertion loss in the passband.

4.3.4 Antenna Matching Network

The harmonic filter presents a 50 Ω impedance to antenna jack J140. A matching network, made up of C140-C141 and L140, is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the impedance presented by the antenna, significantly improving the antenna's efficiency.

4.3.5 Power Control

The power control circuit is a dc-coupled amplifier whose output is the dc gate bias voltage (VGG) applied to the two stages of the RF power amplifier U110.

The output power of the transmitter is adjusted by varying the setting of the power-set DAC contained in the ASFICcmp IC (DACG, U451 pin 6). This PWR_SET voltage is applied to U150 pin 3.

Stage U150-2 compares the voltage drop across current sense resistor R150 to the voltage drop across resistor R151 caused by current flow through Q150, and adjusts its output (pin 7) to maintain equal voltages at pins 5 and 6. Thus the current flow through Q150, and hence its emitter voltage, is proportional to the current drawn by stage U110, which is in turn proportional to the transmitter output power. The emitter voltage of Q150 is applied to U150 pin 2, where it is compared to the power set voltage PWR_SET at pin 3.

The output of U150 pin 1 is divided by R110 and R111 and applied as a gate voltage to the power amplifier U110. By varying this gate voltage as needed to keep the voltages at U150 pins 2 and 3 equal, power is maintained at the desired setting. Excessive final current, for example due to antenna mismatch, causes a lowering of the voltage at U150 pin 6, an increased voltage at pin 2, and a lowering of the voltage at pin 1 and of the gate voltage VGG. This prevents damage to the final stage due to excessive current.

4.4 VHF Frequency Generation Circuitry

The frequency generation system, shown in Figure 4-3, is composed of two circuit blocks, the Fractional-N synthesizer IC U201, the VCO/Buffer IC U251, and associated circuitry. Figure 4-4 shows the peripheral interconnect and support circuitry used in the synthesizer block, and Figure 4-5 details the internal circuitry of the VCOBIC and its interconnections to the surrounding components. Refer to the schematic to identify reference designators.

The Fractional-N synthesizer is powered by regulated 5 V and 3 V provided by U310 and U330 respectively. 5 V is applied to U201 pins 13 and 30, and 3 V is applied to pins 5, 20, 34 and 36. The synthesizer in turn generates a super-filtered 4.5 V supply (VSF, from pin 28) to power U251. In addition to the VCO, the synthesizer also interfaces with the logic and ASFICcmp circuits. Programming for the synthesizer is accomplished through the microprocessor SPI_DATA_OUT, SPI_CLK, and SYNTH_CS (chip select) lines (U409 pins 100, 1 and 47 respectively). A logic high (3 V) from U201 pin 4 indicates to the microprocessor that the synthesizer is locked.

Transmit modulation from the ASFICcmp (U451 pin 40) is applied to U201 pin 10 (MOD_IN). An electronic attenuator in the ASFICcmp adjusts overall transmitter deviation by varying the audio level applied to the synthesizer IC. Internally the audio is digitized by the Fractional-N synthesizer and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for the purpose of balancing the low port and high port modulation and reducing the deviation by 6 dB for 12.5 kHz channels, and is available at U201 pin 41 (VCO_MOD). This audio signal is routed to the VCO's modulator.

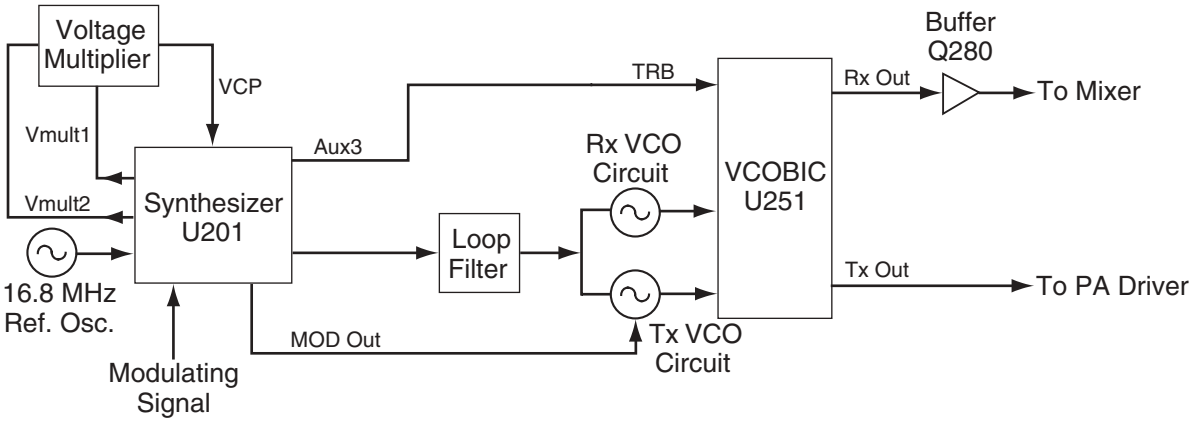


Figure 4-3. VHF Frequency Generation Unit Block Diagram

4.4.1 Fractional-N Synthesizer

The Fractional-N synthesizer, shown in Figure 4-4, uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-C203, R202 and D201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor D201 from U201 pin 25 is determined by a temperature-compensation algorithm within U201, and is specific to each crystal Y201, based on a unique code assigned to the crystal that identifies its temperature characteristics. Stability is better than 2.5 ppm over temperatures of -30 to 60 °C. Software-programmable electronic frequency adjustment is achieved by an internal DAC which provides a frequency adjustment voltage from U201 pin 25 to varactor D201.

The synthesizer IC U201 further divides the 16.8 MHz signal to 2.1 MHz, 2.225 MHz, or 2.4 MHz for use as reference frequencies. It also provides a buffered 16.8 MHz signal at U201 pin 19 for use by the ASFICcmp.

To achieve fast locking of the synthesizer, an internal adapt charge pump provides higher current at U201 pin 45 to quickly force the synthesizer within lock range. The required frequency is then locked by the normal mode charge pump at pin 43. A loop filter (C243-C245 and R243-R245) removes noise and spurs from the steering voltage applied to the VCO varactors, with additional filtering located in the VCO circuit.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C221-C224 and D220-D221. Two 3 V square waves from U201 pins 14-15 provide the drive signals for the voltage multiplier, which generates 12.1 V at U201 pin 47. This voltage is filtered by C225-C228.

One of the auxiliary outputs of the synthesizer IC (AUX3, U201 pin 2) provides the TRB signal which determines the operating mode of the VCO, either receive or transmit.

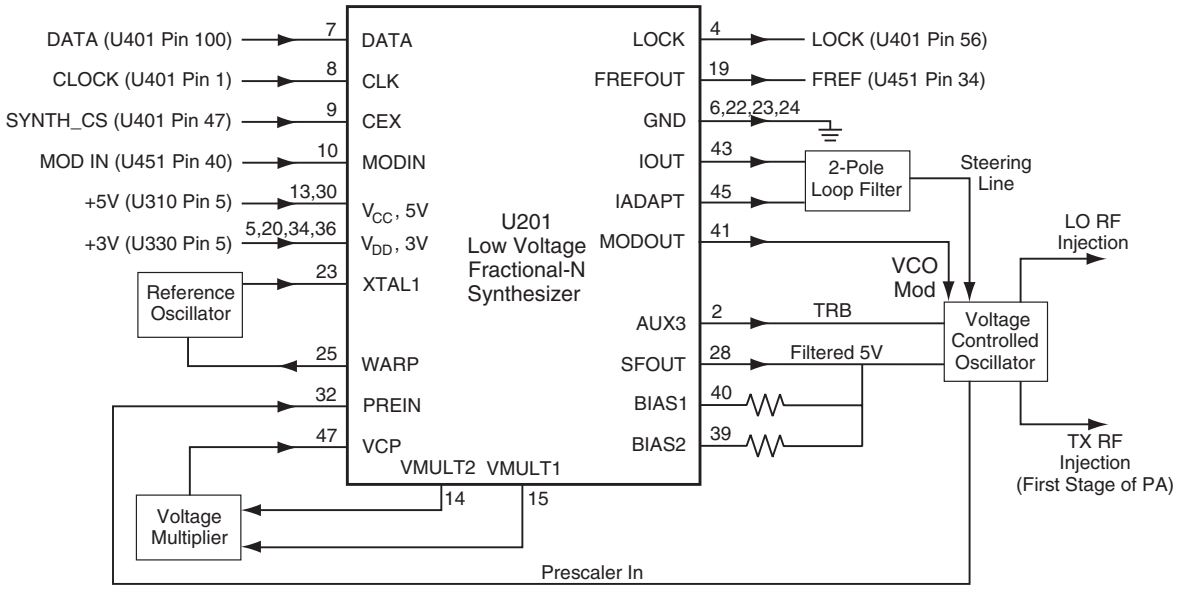


Figure 4-4. VHF Synthesizer Block Diagram

4.4.2 Voltage Controlled Oscillator (VCO)

The VCOBIC (U251), shown in Figure 4-5, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U251 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U251 pin 12 through a low pass filter, to the prescaler input of the synthesizer IC (U201 pin 32). After frequency comparison in the synthesizer, a resultant DC control voltage is used to steer the VCO frequency. When the PLL is locked on frequency, this voltage can vary between 3 V and 9 V. L251 and C251 further attenuate noise and spurs on the steering line voltage.

In the receive mode, the TRB line (U251 pin 19) is low. This activates the receive VCO and the receive buffer of U251, which operate within the range of 180.85 to 206.85 MHz. The VCO frequency is determined by tank inductor L254, C253-C257, and varactor D251. The buffered RF signal at U251 pin 8 is further amplified by Q280 and applied as RX_INJ to the low-pass injection filter in the receiver front end circuit.

In the transmit mode, U251-19 is driven high by U201 pin 2, enabling the transmit VCO and buffer. The 136-162 MHz RF signal from U251 pin 10 is applied as TX_INJ to the input of the transmitter circuit via matching network C290-C291 and L291. TX VCO frequency is determined by L264, C263-

C267, and varactor D261. High-port audio modulation from the synthesizer IC is applied as VCO_MOD to varactor D262 which modulates the transmit VCO.

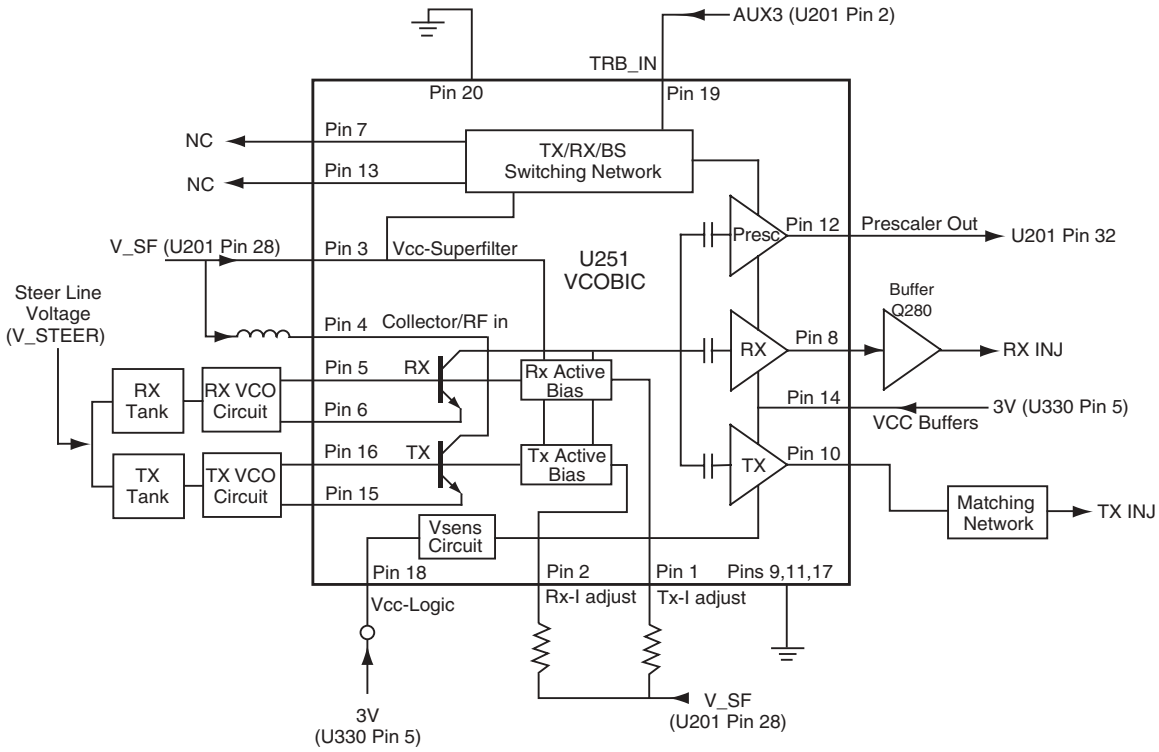


Figure 4-5. VHF VCO Block Diagram

Notes:

Chapter 5 146-174 MHz VHF Theory Of Operation

5.1 Introduction

This chapter provides a detailed theory of operation for the radio components. Schematic diagrams for the circuits described in the following paragraphs are located in Chapter 7 of this manual.

5.2 VHF Receiver

The VHF receiver covers the range of 146-174 MHz and provides switchable IF bandwidth for use with 12.5 kHz or 20/25 kHz channel spacing systems. The receiver is divided into two major blocks as shown in Figure 5-1.

- Front End
- Back End

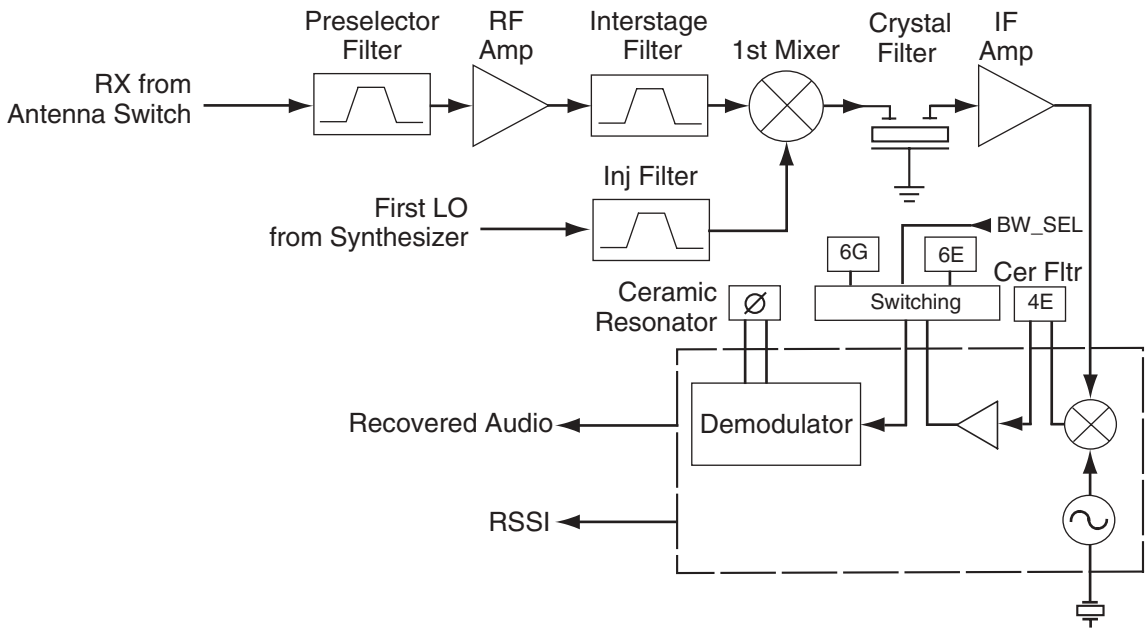


Figure 5-1. VHF Receiver Block Diagram

5.2.1 Receiver Front-End

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, an interstage filter, and a double-balanced first mixer.

The preselector filter is a fixed-tuned 4-pole design using discrete elements (L1-L4 and C1-C9) in a series/shunt resonator configuration. It has a 3 dB bandwidth of 44 MHz, an insertion loss of 2 dB and image attenuation of 40 dB at 235 MHz, with increasing attenuation at higher frequencies. Diode CR1 protects the RF amplifier by limiting excessive RF levels.

The output of the filter is matched to the base of RF amplifier Q21, which provides 18 dB of gain and a noise figure of 2 dB. Operating voltage is obtained from the 5R source, which is turned off during transmit to reduce dissipation in Q21. Current mirror Q22 maintains the operating current of Q21

constant at 6.2 mA regardless of device and temperature variations, for optimum dynamic range and noise figure.

The output of the RF amplifier is applied to the interstage filter, a fixed-tuned 3-pole series-coupled resonator design having a 3 dB bandwidth of 58 MHz and insertion loss of 1.8 dB. This filter has an image rejection of 42 dB at 235 MHz, with increasing attenuation at higher frequencies.

The output of the interstage filter is connected to the passive double-balanced mixer consisting of components T41, T42, and CR41. This mixer has a conversion loss of 7 dB. High-side injection from the frequency synthesizer is filtered by L40-L41 and C40-C44 to remove second harmonic energy that may degrade half-IF spurious rejection performance. The injection filter has a 3 dB bandwidth of 52 MHz and an insertion loss of 1.5 dB. The filtered injection signal is applied to T42 at a level of +6 dBm.

The mixer output is applied to a diplexer network (L51-L52, C51, R51) which matches the 44.85 MHz IF signal to crystal filter FL51, and terminates the mixer into 50Ω at all other frequencies

5.2.2 Receiver Back-End

The receiver back end is a dual conversion design. High IF selectivity is provided by FL51, a 4-pole fundamental mode 44.85 MHz crystal filter with a minimum 3 dB bandwidth of + 6.7 kHz, a maximum 20 dB bandwidth of ±12.5 kHz, and a maximum insertion loss of 3.5 dB. The output is matched to IF amplifier stage Q51 by L53 and C93. Q51 provides 16 dB of gain and a noise figure of 1.8 dB. The dc operating current is 1 mA. The output of Q51 is applied to the input of the receiver IFIC U51. Diode CR51 limits the maximum RF level applied to the IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio and RSSI op amps. The second LO frequency, 44.395 MHz, is determined by Y51. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters, FL52 (between the second mixer and IF amp) and FL53 or FL54 (between the IF amp and the limiter input). The wider filter FL53 is used for 20/25 kHz channel spacing, and the narrower filter FL54 is used for 12.5 kHz channels. When the BW_SEL line is high, the two upper diodes in packages D51 and D52 are forward biased, selecting FL53 for 20/25 kHz channels. When the BW_SEL line is low, the two lower diodes in packages D51 and D52 are forward biased, selecting FL54 for 12.5 kHz channels.

	FL52	FL53	FL54
Number of Elements:	4	6	6
Insertion Loss:	4 dB	4 dB	4 dB
6 dB Bandwidth:	15 kHz	15 kHz	9 kHz
50 dB Bandwidth:	30 kHz	30 kHz	22 kHz
Stopband Rejection:	27 dB	47 dB	47 dB

Ceramic resonator Y70 provides phase vs. frequency characteristic required by the quadrature detector, with 90 degree phase shift occurring at 455 kHz. Buffer Q70 provides a lower driving impedance from the limiter to the resonator, improving the IF waveform and lowering the distortion of the recovered audio signal. The recovered audio level at the DEMOD output is 120 mV rms (25 kHz channel, 3 kHz deviation) or 60 mV rms (12.5 kHz channel, 1.5 kHz deviation). An additional RSSI output provides a DC voltage level that is proportional to RF signal level. This voltage is measured by an A/D converter contained in the microprocessor (PE4_AN4, U401 pin 63).

5.3 VHF Transmitter

The VHF transmitter covers the range of 146-174 MHz. Depending on model, the output power of the transmitter is either switchable on a per-channel basis between high power (5 watts) and low power (1 watt), or is factory preset to 2 watts. The transmitter is divided into four major blocks as shown in Figure 5-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control

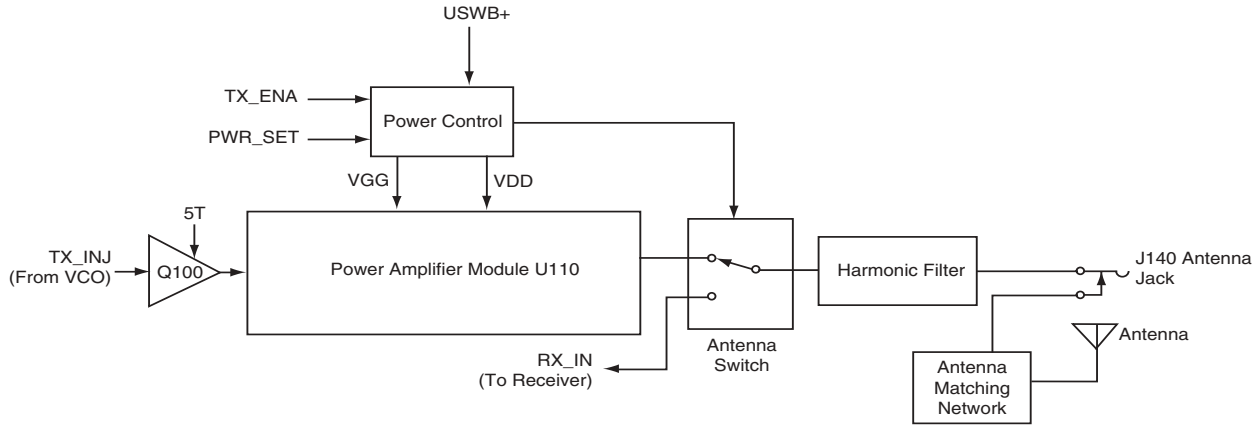


Figure 5-2. VHF Transmitter Block Diagram

5.3.1 Transmit Power Amplifier

The transmitter power amplifier has three stages of amplification. The first stage, Q100, operates in Class AB from the 5T source. It provides 13 dB of gain and an output of 20 mW. The current drain is typically 25mA. Components C105-C107 and L103 match the output of Q100 to the 50Ω input of the module U110.

U110 is a two stage Silicon MOS FET power amplifier module. Drain voltage is obtained from UNSW B+ after being routed through current-sense resistor R150 in the power control circuit. The output power of the module is controlled by varying the DC gate bias on U110 pin 2 (VGG).

5.3.2 Antenna Switch

The antenna switch consists of two pin diodes, D120 and D121. In the receive mode, both diodes are off. Signals applied at the antenna or at jack J140 are routed, via the harmonic filter, through network C122-C124 and L121, to the receiver input. In the transmit mode, Q170 is on and TXB+ is present, forward-biasing both diodes into conduction. The diode current is 50 mA, set by R120-R122. The transmitter RF from U110 is routed through D120, and via the harmonic filter to the antenna jack. D121 conducts, shunting RF power and preventing it from reaching the receiver. L121 is selected to appear as a 1/4 wave at VHF, so that the low impedance of D121 appears as a high impedance at the junction of D120 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

5.3.3 Harmonic Filter

The harmonic filter consists of components C130-C136 and L130-L132. The harmonic filter is a seven-pole elliptical low-pass configuration, optimized for low insertion loss, with a 3 dB frequency of approximately 210 MHz and typically less than 0.8 dB insertion loss in the passband.

5.3.4 Antenna Matching Network

The harmonic filter presents a 50 Ω impedance to antenna jack J140. A matching network, made up of C140-C141 and L140, is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the impedance presented by the antenna, significantly improving the antenna's efficiency.

5.3.5 Power Control

The power control circuit is a dc-coupled amplifier whose output is the dc gate bias voltage (VGG) applied to the two stages of the RF power amplifier U110.

The output power of the transmitter is adjusted by varying the setting of the power-set DAC contained in the ASFICcmp IC (DACG, U451 pin 6). This PWR_SET voltage is applied to U150 pin 3.

Stage U150-2 compares the voltage drop across current sense resistor R150 to the voltage drop across resistor R151 caused by current flow through Q150, and adjusts its output (pin 7) to maintain equal voltages at pins 5 and 6. Thus the current flow through Q150, and hence its emitter voltage, is proportional to the current drawn by stage U110, which is in turn proportional to the transmitter output power. The emitter voltage of Q150 is applied to U150 pin 2, where it is compared to the power set voltage PWR_SET at pin 3.

The output of U150 pin 1 is divided by R110 and R111 and applied as a gate voltage to the power amplifier U110. By varying this gate voltage as needed to keep the voltages at U150 pins 2 and 3 equal, power is maintained at the desired setting. Excessive final current, for example due to antenna mismatch, causes a lowering of the voltage at U150 pin 6, an increased voltage at pin 2, and a lowering of the voltage at pin 1 and of the gate voltage VGG. This prevents damage to the final stage due to excessive current.

5.4 VHF Frequency Generation Circuitry

The frequency generation system, shown in Figure 5-3, is composed of two circuit blocks, the Fractional-N synthesizer IC U201, the VCO/Buffer IC U251, and associated circuitry. Figure 5-4 shows the peripheral interconnect and support circuitry used in the synthesizer block, and Figure 5-5 details the internal circuitry of the VCOBIC and its interconnections to the surrounding components. Refer to the schematic to identify reference designators.

The Fractional-N synthesizer is powered by regulated 5 V and 3 V provided by U310 and U330 respectively. 5 V is applied to U201 pins 13 and 30, and 3 V is applied to pins 5, 20, 34 and 36. The synthesizer in turn generates a super-filtered 4.5 V supply (VSF, from pin 28) to power U251. In addition to the VCO, the synthesizer also interfaces with the logic and ASFICcmp circuits. Programming for the synthesizer is accomplished through the microprocessor SPI_DATA_OUT, SPI_CLK, and SYNTH_CS (chip select) lines (U409 pins 100, 1 and 47 respectively). A logic high (3 V) from U201 pin 4 indicates to the microprocessor that the synthesizer is locked.

Transmit modulation from the ASFICcmp (U451 pin 40) is applied to U201 pin 10 (MOD_IN). An electronic attenuator in the ASFICcmp adjusts overall transmitter deviation by varying the audio level applied to the synthesizer IC. Internally the audio is digitized by the Fractional-N synthesizer and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for the purpose of balancing the low port and high port modulation and reducing the deviation by 6 dB for 12.5 kHz channels, and is available at U201 pin 41 (VCO_MOD). This audio signal is routed to the VCO's modulator.

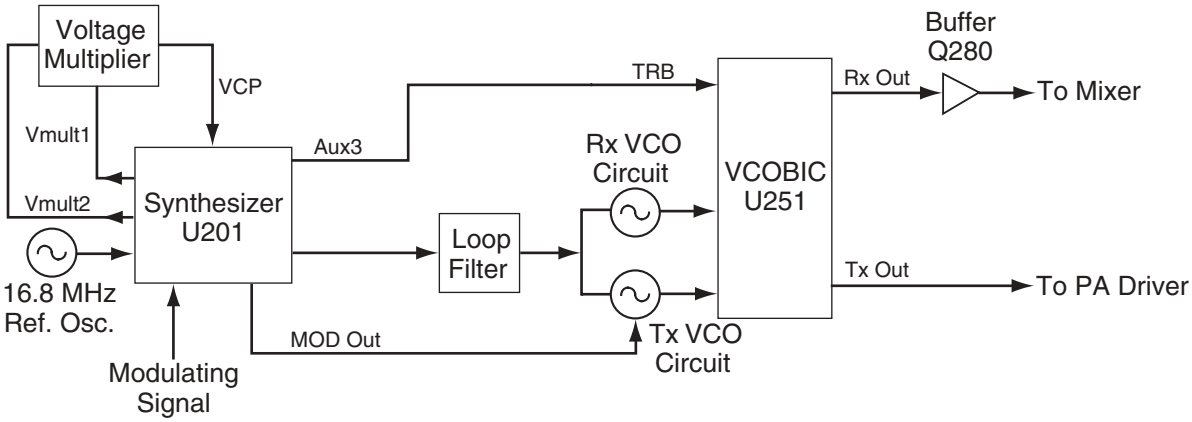


Figure 5-3. VHF Frequency Generation Unit Block Diagram

5.4.1 Fractional-N Synthesizer

The Fractional-N synthesizer, shown in Figure 5-4, uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-C203, R202 and D201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor D201 from U201 pin 25 is determined by a temperature-compensation algorithm within U201, and is specific to each crystal Y201, based on a unique code assigned to the crystal that identifies its temperature characteristics. Stability is better than 2.5 ppm over temperatures of -30 to 60 °C. Software-programmable electronic frequency adjustment is achieved by an internal DAC which provides a frequency adjustment voltage from U201 pin 25 to varactor D201.

The synthesizer IC U201 further divides the 16.8 MHz signal to 2.1 MHz, 2.225 MHz, or 2.4 MHz for use as reference frequencies. It also provides a buffered 16.8 MHz signal at U201 pin 19 for use by the ASFICcmp.

To achieve fast locking of the synthesizer, an internal adapt charge pump provides higher current at U201 pin 45 to quickly force the synthesizer within lock range. The required frequency is then locked by the normal mode charge pump at pin 43. A loop filter (C243-C245 and R243-R245) removes noise and spurs from the steering voltage applied to the VCO varactors, with additional filtering located in the VCO circuit.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C221-C224 and D220-D221. Two 3 V square waves from U201 pins 14-15 provide the drive signals for the voltage multiplier, which generates 12.1 V at U201 pin 47. This voltage is filtered by C225-C228.

One of the auxiliary outputs of the synthesizer IC (AUX3, U201 pin 2) provides the TRB signal which determines the operating mode of the VCO, either receive or transmit.

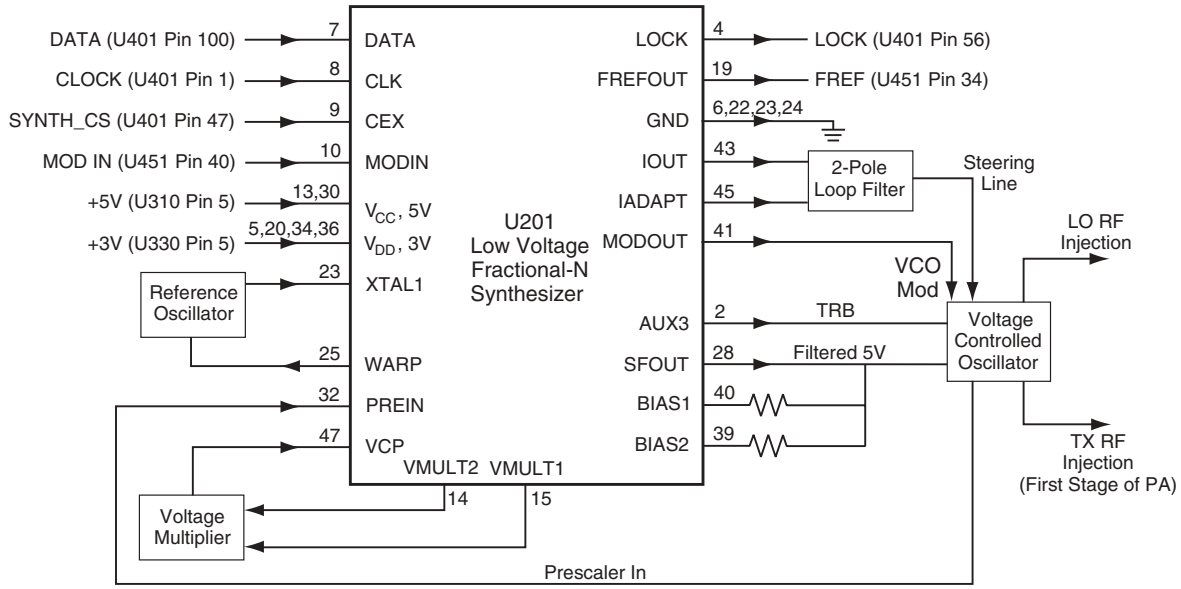


Figure 5-4. VHF Synthesizer Block Diagram

5.4.2 Voltage Controlled Oscillator (VCO)

The VCOBIC (U251), shown in Figure 5-5, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U251 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U251 pin 12 through a low pass filter, to the prescaler input of the synthesizer IC (U201 pin 32). After frequency comparison in the synthesizer, a resultant DC control voltage is used to steer the VCO frequency. When the PLL is locked on frequency, this voltage can vary between 3 V and 9 V. L251 and C251 further attenuate noise and spurs on the steering line voltage.

In the receive mode, the TRB line (U251 pin 19) is low. This activates the receive VCO and the receive buffer of U251, which operate within the range of 190.85 to 218.85 MHz. The VCO frequency is determined by tank inductor L254, C253-C257, and varactor D251. The buffered RF signal at U251 pin 8 is further amplified by Q280 and applied as RX_INJ to the low-pass injection filter in the receiver front end circuit.

In the transmit mode, U251-19 is driven high by U201 pin 2, enabling the transmit VCO and buffer. The 146-174 MHz RF signal from U251 pin 10 is applied as TX_INJ to the input of the transmitter circuit via matching network C290-C291 and L291. TX VCO frequency is determined by L264, C263-

C267, and varactor D261. High-port audio modulation from the synthesizer IC is applied as VCO_MOD to varactor D262 which modulates the transmit VCO.

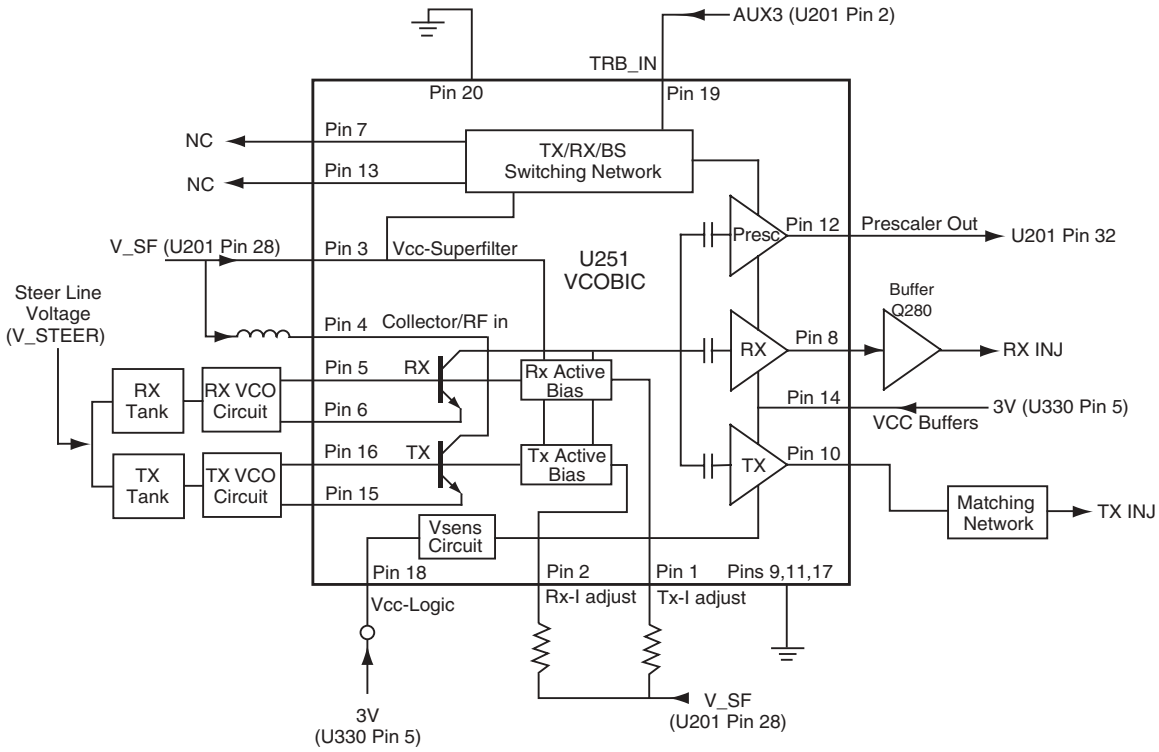


Figure 5-5. VHF VCO Block Diagram

Notes:

Chapter 6 VHF Troubleshooting Tables

6.1 Troubleshooting Table for Receiver

Table 6-1. Troubleshooting Table for Receiver

Symptom	Possible Causes	Procedure	Corrective Action
Radio Dead (no turn-on beep, no LED indication)	1. Battery dead or defective.	Substitute known good battery or battery eliminator.	Charge or replace battery.
	2. Defective battery contacts.	Inspect battery contacts for corrosion or bent terminals.	Clean/repair/replace J301.
	3. Blown fuse	Check voltage on each side of fuse. If blown, 0 VDC after fuse.	Check for short on output, check D301, VR301, troubleshoot/repair as needed, replace fuse.
	4. DC switching fault	Verify battery voltage present at S444 pin 5 when radio is on. Verify Q494-1 is at least 1 V dc, Q494-6 is ~0.1 V dc, Q493-3 is at Vbatt.	Check/replace on-off-volume control S444. Troubleshoot/replace Q493/4.
	5. Microprocessor not starting up.	Verify clock input to U401-90 (EXTAL) is 7.3975 MHz using high impedance probe. If clock is 3.8 MHz, check for shorts on U401 pins. Connect RIB to verify communication via CPS. Verify U401-94 (RESET) is high.	Verify 16.8 MHz signal at U451-34. If OK, troubleshoot/replace U451. If not present, troubleshoot U201 Synthesizer. Reprogram/reflash as needed. If RESET is Low, troubleshoot regulator U320. Check for shorts at U401 pins. Replace U401 (depot only). Reprogram/reflash as needed.
	6. Regulator fault	Verify U310-5 is 5 V dc, U320-5 is 3.3 V dc, U330-5 is 3 V dc.	Check for shorts on outputs, troubleshoot/repair as needed, replace faulty regulator.

Table 6-1. Troubleshooting Table for Receiver (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
No Audio	1. Synthesizer out of lock	Verify U201-4 is at 3 V dc.	Troubleshoot synthesizer/VCO circuits.
	2. Defective IFIC	Verify audio is present at U51-8.	Check Q70, Y70, U51.
	3. RX audio buffer fault	Verify audio is present at U451-2.	Check U510 and associated parts.
	4. ASFIC fault	Verify audio is present at U451-41. Verify U451-14 is high.	Check squelch setting, PL/DPL programming. Troubleshoot/ replace U451.
	5. Audio PA fault	Verify U490-1 is <0.2 V dc. Verify audio is present at U490-5 and 8.	Check Q490. Check/replace U490.
	6. Defective speaker	Verify audio is present at speaker terminals.	If not, check continuity of J471-2 and 3. Check J491. If yes, replace speaker.
No Receive (squelch noise present)	1. No first injection	Check that RF level at T42-6 is approx +6 dBm. Check that RF level at U251-8 is at least -8 dBm.	Check injection filter C40-44, L40-41. If yes, check Q280 and associated parts. If no, check U251 and components on pins 5 and 6.
	2. No 5R source.	Verify U401-49 is high in RX. Verify Q311 gate is 0 V dc in RX Verify Q311 drain is 5 V dc in RX.	Check/replace U401 Check/replace Q313. Check for shorts, check/replace Q311.
	3. Harmonic filter or antenna switch fault	Apply on-channel 100 mV RF signal at antenna port. Verify RF level at jct. C1/C2 per schematic.	Check TX harmonic filter, D120-121. Should be 0 V dc on D120-121.
	4. Back end fault	Apply on-channel 100 mV RF signal at antenna port. Measure RF levels from FL51 through U51.	Check components prior to loss-of-signal point.
	5. No second injection	Measure RF level at U51-3, verify approx. 280 mV rms.	If dc voltages at U51-3 and 4 are OK, check Y51 and associated parts. If not replace U51.

6.2 Troubleshooting Table for Synthesizer

Table 6-2. Troubleshooting Table for Synthesizer

Symptom	Possible Causes	Procedure	Corrective Action
Synthesizer Out of Lock (RX mode only)	1. VCO fault	Verify oscillator is working, check RF level at U251-10 per schematic. Check dc voltages at U251 pin 2 through 6 and 10 per Table 6-4. Verify steering line voltage is between ~3 V and 10 V.	Check VCO tank components connected to U251-5 and 6. Check for shorts/opens, replace U251. Check D251 and associated components.
	2. Synthesizer fault	Verify TRB line (from U201-2 to U251-19) is low in RX mode	Check for shorts, check U201 voltages per Table 6-4, replace U201 if incorrect.
	3. Programming fault	Verify RX channel programming is correct.	Re-program if necessary.
Synthesizer Out of Lock (TX mode only)	1. VCO fault	Verify oscillator is working, check RF level at U251-10 per schematic. Check dc voltages at U251 pins 1,3,4,10,15,16 per Table 6-4. Verify steering line voltage is between ~3 V and 10 V.	Check VCO tank components connected to U251-15 and 16. Check for shorts/opens, replace U251. Check D261 and associated components.
	2. Synthesizer fault	Verify TRB line (U201-2 to U251-19) is high (3 V) in TX mode	Check for shorts, check U201 voltages per Table 6-4, replace U201 if incorrect.
	3. Programming fault	Verify TX channel programming is correct.	Re-program if necessary.
Synthesizer Out of Lock (RX and TX modes)	1. VCO fault	Check that RF level at U251-12 is at least 150 mV (VHF) or -12 to -20 dBm (UHF)	If low/missing, check L276, C276-7, R276.
	2. Synthesizer fault	Check that RF level at U201-32 is at least 150 mV (VHF) or -12 to -20 dBm (UHF). Verify steering line voltage is between ~3 V and 10 V.	If correct, check/replace U201. If incorrect, check R248 and C241. Check loop filter components R243-5 and C243-5.
	3. DC voltage fault	Verify 4.5 V dc at U201-28. Verify 12.1 V dc at U201-47	Check C231-233, etc., for shorts. If OK check/replace U201. Check for 3 V 1.05 MHz sq waves at U201-14 and 15. Check C218-228, D220-221.
	4. Programming fault	Verify channel programming is correct.	Re-program if necessary.

6.3 Troubleshooting Table for Transmitter

Table 6-3. Troubleshooting Table for Transmitter

Symptom	Possible Causes	Procedure	Corrective Action
No Transmit (no TX LED indication)	1. PTT switch defective.	Verify U401-71 goes low when PTT is pressed.	Replace PTT switch S441.
	2. EXT MIC PTT fault	Verify U401-72 goes low when J471-4 is grounded.	Check/replace Q470, L471 etc.
No Transmit (TX LED indication OK)	1. Synthesizer out of lock	Refer to Table 6-2.	Refer to Table 6-2.
	2. No TX_ENABLE	Verify U401-50 is high when pin 71 or 72 is low.	Check/replace U401.
	3. TX DC switch fault	Verify Q171-C is 0 V in TX. Verify Q170-C is at Vbatt in TX.	Replace Q171. Check for shorts, replace Q170.
	4. Power control fault	Check Q150 and U150 dc voltages per schematic and Table 6-4.	Repair/replace defective components
	5. No TX injection	Check that RF level at jct. R100/R101 per schematic.	Check U251, L291-292, C290-291.
	6. No 5T source	Verify Q312 gate is 0 V dc in TX Verify Q312 drain is 5 V dc in TX.	Check/replace Q313. Check for shorts, check/replace Q312.
	7. TX gain stage failure	Check RF levels at Q100 and U110 per schematic.	Troubleshoot Q100/U110 and associated circuitry.
	8. Antenna switch failure	Verify dc voltage at jct. R122/L120 is approx 1.5 V.	Check/replace D120-121, L120-121, R120-122, etc.

Table 6-3. Troubleshooting Table for Transmitter (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
Low Power	1. Low TX injection	Check that RF level at jct. R100/ R101 per schematic.	Check U251, L291-292, C290-291.
	2. Low gain in TX stage	Verify dc voltage at Q100-E is ~1.3 V (VHF) or ~0.5 V (UHF). Verify that RF level at U110-1 is approx. 1 V (VHF) or 1.6 V (UHF).	Verify 5T voltage is correct. Troubleshoot Q100 circuitry. Troubleshoot Q100 circuitry. Check/replace Q100.
	3. Incorrect control voltage	Verify that the dc voltage at PWR_SET (R162) is approx 1.8 V dc (at 1 watt) to 2.6 V dc (at 4-5 watts). Verify that the dc voltage at U110-2 is approx 2-3 V dc (at 1 watt) to 3-4 V dc (at 4-5 watts). (See schematic.)	Check programming. Troubleshoot controller circuitry. Check/ replace U451. Troubleshoot U150, Q150 and associated circuitry.
	4. Antenna switch defect	Verify dc voltage at jct. R122/L120 (VHF) or R121/L120 (UHF) is approx 1.7 V. *Note: Do not attempt to measure RF or DC voltages at the diodes. Damage to test equipment may occur.*	Check/replace D120-121, L120-121, R120-122, etc.
	5. Harmonic filter defect	Visually inspect components C130-137, L130-132. Check dc continuity of L130-132 *in RX mode only*.	Repair/replace if necessary.
Poor TX range, conducted power OK	1. RF test jack defective	Verify continuity of J140 pins 3 and 4 *in RX mode only*.	Replace J140.
	2. Antenna matching network fault	Visually inspect components C140-141, L140 or L141. Check dc continuity of L140 or L141*in RX mode only*.	Repair/replace if necessary.
	3. Defective or wrong antenna	Verify correct antenna is installed. Try another antenna.	Replace antenna.
No internal mic audio (EXT MIC audio OK)	1. Mic bias fault	Verify U451-35 is low when side PTT is pressed. Verify Q470-6 is high when side PTT button is pressed.	Check/replace U451. Check/replace R474, R476, and Q470.
	2. Defective mic	Verify approx 1.8 V dc across cartridge when side PTT button is pressed. Verify audio present (~10 mV rms) when speaking into mic.	Check mic connector and R478. Replace mic cartridge.
	3. Defective mic jack	Verify continuity between J471 pins 4 and 5.	Replace J471.

Table 6-3. Troubleshooting Table for Transmitter (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
No EXT MIC audio	1. Mic bias fault	Verify approx 1.8 V dc across EXT MIC cartridge in TX mode. Verify audio present (~10 mV rms) when speaking into mic.	Check Q470. R475, R477, L471. Check VR473, VR475, D470 for shorts.
	2. Audio path fault	Verify mic audio present (~10 mV rms) at U451-46. Verify amplified mic audio present (~200 mV rms) at U451-40.	Check L471, C470. Check/replace U451.
	3. Defective audio accessory	Try another accessory.	Replace defective accessory.

6.4 Troubleshooting Table for Board and IC Signals

Table 6-4. Troubleshooting Table for Board and IC Signals

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U51 IFIC	1	RF input 44.85 MHz	1.20	
	2	RF input decoupling	1.20	
	3	2nd LO osc output	4.02	
	4	2nd LO osc input	4.60	
	5	RSSI output	0.74	(no received signal)
	6	Vcc	4.70	
	7	Audio feedback	0.89	
	8	Audio output	1.44	DEMOD to stage U510
	9	RSSI feedback	0.74	(no received signal)
	10	Quad detector input	2.22	
	11	Limiter output	1.25	
	12	Limiter decoupling 2	1.30	
	13	Limiter decoupling 1	1.30	
	14	Limiter input	1.28	
	15	Ground	GND	
	16	IF amp output	1.22	
	17	IF amp decoupling 2	1.26	
	18	IF amp input	1.26	
	19	IF amp decoupling 1	1.26	
	20	2nd mixer output	3.09	
U52 BW Select Switch	1	Inverter 1 input	0	(25 kHz mode)
	2	Inverter 2 output	0	(25 kHz mode)
	3	Inverter 3 input (NU)	GND	
	4	Ground	GND	
	5	Inverter 3 output (NU)	4.96	
	6	Inverter 2 input	3.00	(25 kHz mode)
	7	Inverter 1 output	4.95	(25 kHz mode)
	8	Vcc	4.96	

Table 6-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U110 RF Power Amp	1	RF input	0	(TX mode)
	2	Vgg (gate bias)	2.65 (typ)	(TX mode) (4.25 V typ at VHF)
	3	Vdd	6.59	(TX mode)
	4	RF output	--	Do not measure
	5	Ground	GND	
U150 Dual Opamp	1	Unit 1 output	4.20 (typ)	(TX mode) (5.8 V typ at VHF)
	2	Unit 1 (-) input	2.39 (typ)	(TX mode)
	3	Unit 1 (+) input	2.39 (typ)	(TX mode)
	4	Ground	GND	
	5	Unit 2 (+) input	3.30 (typ)	(TX mode)
	6	Unit 2 (-) input	3.35 (typ)	(TX mode)
	7	Unit 2 output	2.23 (typ)	(TX mode)
	8	Vcc	6.79	(TX mode)
U201 Freq Synthesizer	1	AUX2 output (NU)	0	
	2	AUX3 output (TRB)	0.03	To U251-19 (RX mode)
	3	AUX4 output (NU)	0	
	4	Lock detect output	2.98	To U401-56
	5	PD Vdd	2.98	
	6	Digital ground	GND	
	7	Serial data input	3.23	
	8	Serial clock input	0	
	9	Synth chip select	3.23	From U401-47
	10	Modulation input	1.50	From U451-40
	11	VMULT4 (NU)	2.98	
	12	VMULT3 (NU)	0	
	13	VRO	4.96	
	14	VMULT2	1.49	
	15	VMULT1	1.49	
	16	INDMULT (NU)	0	
	17	NC1	0	
	18	Ref select (NU)	0	
	19	Buffered 16.8 MHz out	1.54	
	20	Analog Vdd	3.00	
	21	V bypass (NU)	1.55	
	22	Analog ground	GND	
	23	Ref osc XTAL1	2.07	

Table 6-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U201 Freq Synthesizer	24	Ref osc XTAL2	0	
	25	Ref osc warp output	3.00	
	26	Superfilter cap	4.48	
	27	Superfilter base (NU)	3.76	
	28	Superfilter output	4.52	
	29	NC2	0	
	30	Superfilter input	4.96	
	31	NC3	0	
	32	Prescaler input	1.97	
	33	Prescaler ground	GND	
	34	Prescaler Vdd	2.99	
	35	Prescaler Vref (NU)	1.97	
	36	Digital Vdd	2.99	
	37	TEST1 (NU)	0.01	
	38	TEST2 (NU)	0	
	39	Bias 2	3.38 (typ)	(1.34 V in TX mode)
	40	Bias 1	1.50 (typ)	(3.20 V in TX mode)
	41	Modulation output	3.42 (typ)	(1.62 V typ in TX mode)
	42	CCOMP (NU)	0.05	
	43	Steering line IOUT	9.62 (typ)	Depends on frequency
	44	PD ground	GND	
	45	Steering line IADAPT	9.62 (typ)	Depends on frequency
	46	Adapt switch (NU)	0	
	47	Voltage from charge pump	12.8	
	48	AUX1 output (NU)	2.98	
U251 VCO / Buffer	1	TX VCO current adjust	4.50	
	2	RX VCO current adjust	4.35	
	3	Superfiltered input	4.51	
	4	Collector RF in amp	4.35	
	5	RX VCO base	1.27	
	6	RX VCO emitter	0.48	
	7	RX switch output (NU)	0	
	8	RX buffered VCO output	3.36	
	9	GND_FLAG	GND	
	10	TX buffered VCO output	3.36	
	11	GND_BUFFERS	GND	

Table 6-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U251 VCO / Buffer	12	Prescaler output	2.26	
	13	TX switch output (NU)	0.06	
	14	Vcc_BUFFERS	3.00	
	15	TX VCO emitter	0	(RX mode)
	16	TX VCO base	0	(RX mode)
	17	GND_LOGIC	GND	
	18	Vcc_LOGIC	3.00	
	19	TRB input	0.03	From U201-2 (RX mode)
	20	FLIP input	GND	
U310 5 V Regulator	1	Vin	7.48	
	2	Ground	GND	
	3	Control input	7.48	
	4	Bypass capacitor	1.26	
	5	Vout	4.96	
U320 3.3 V Regulator	1	Ground	GND	
	2	Feedback	1.23	
	3	Tap (NU)	0	
	4	Vin	7.48	
	5	Vout	3.23	
	6	Sense (NU)	0	
	7	Error (reset output)	3.20	
	8	Shutdown input	7.48	
U330 3 V Regulator	1	Vin	7.48	
	2	Ground	GND	
	3	Control input	7.48	
	4	Bypass capacitor	1.26	
	5	Vout	3.00	
U401 Microprocessor	1	PD4_SCK serial clock input	0	
	2	PD5_SS	3.23	ASFIC chip select
	3	PD6_VLIN	3.23	EEPROM chip select
	4	PG7_R_W	3.21	
	5	PG6_AS	3.23	
	6	PG0_XA13	3.23	
	7	PB7_ADDR15	0.026	
	8	PB6_ADDR14	0.028	
	9	PB3_ADDR11	3.06	

Table 6-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	10	PB1_ADDR9	3.05	
	11	PB2_ADDR10	0.16	
	12	VDD	3.23	
	13	VSS	GND	
	14	PBO_ADDR8	3.05	
	15	PB5_ADDR13	0.13	
	16	PG1_XA14	0.20	
	17	PG4_XA17	3.17	
	18	PG5_XA18	0	
	19	PG3_XA16	3.21	
	20	PG2_XA15	0.30	
	21	PB4_ADDR12	0.22	
	22	PF7_ADDR7	3.03	
	23	PF6_ADDR6	3.08	
	24	PF5_ADDR5	3.06	
	25	PF4_ADDR4	0.16	
	26	PF3_ADDR3	0.26	
	27	PF2_ADDR2	3.06	
	28	PF1_ADDR1	3.06	
	29	PFO_ADDR0	3.05	
	30	PC0_DATA0	0.69	
	31	PC1_DATA1	0.96	
	32	PC2_DATA2	1.10	
	33	PC3_DATA3	0.81	
	34	PC4_DATA4	0.62	
	35	PC5_DATA5	0.68	
	36	PC6_DATA6	0.67	
	37	PC7_DATA7	0.73	
	38	PH7_CSPROG	3.05	
	39	VDDL	3.23	
	40	VSSL	GND	
	41	PH6_CSGP2	3.23	
	42	PH5_CSGP1	3.23	
	43	PH4_CSIO	0	
	44	PH3_PW4	3.21	On/off control output
	45	PH2_PW3	0	

Table 6-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	46	PH1_PW2	3.00	
	47	PH0_PW1	3.23	Synth chip select
	48	XIRQ	3.00	
	49	PI7	1.48	RX enable
	50	PI6	0.01	TX enable
	51	PI5	3.23	
	52	PI4	0	Green LED enable
	53	PI3	0	Red LED enable
	54	PI2	0	
	55	PI1	0	
	56	PI0	2.98	Lock detect from U201-4
	57	MODB_VSTBY	3.22	Boot mode enable
	58	MODA_LIR	3.12	
	59	AVDD	3.23	
	60	PE7_AN7	3.20	
	61	PE6_AN6	3.20	
	62	PE5_AN5	2.91	VOX threshold detect
	63	PE4_AN4	0.73	RSSI input
	64	PE3_AN3	0.14	
	65	PE2_AN2	1.62	
	66	PE1_AN1	0 - 3.3 V	Volume control wiper
	67	PE0_AN0	2.48	33% of battery voltage
	68	VRL	0	
	69	VRH	3.20	
	70	AVSS	GND	
	71	PJ0_CSGP3	3.23	Side PTT button
	72	PJ1_CSGP4	0	External MIC PTT
	73	PJ2	3.23	
	74	PJ3	3.23	
	75	PJ4	3.23	
	76	PJ5	0	
	77	PJ6	3.23	Bottom option button
	78	PJ7	3.23	Top option button
	79	PA0_IC3	0	
	80	PA1_IC2	1.57	
	81	PA2_IC1	3.00	

Table 6-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	82	PA3_IC4_OC5_OC1	3.00	
	83	PA4_OC4_OC1	0	Squelch detect input
	84	PA5_OC3_OC1	0	Channel activity input
	85	PA6_OC2_OC1	0	
	86	PA7_PA1_OC1	0	
	87	VSSR	GND	
	88	VDDR	3.23	
	89	ECLK (NU)	1.60	
	90	EXTAL	1.70	Clock from U451-28
	91	XTAL	1.40	Not used
	92	VDDSYN	0	
	93	XFC (NU)	0	
	94	RESET	3.20	From U320
	95	LVOUT	0	
	96	IRQ	3.20	
	97	PD0_RXD	3.23	
	98	PD1_TXD	1.9	
	99	PD2_MISO	0	
	100	PD3_MOSI	3.23	
U402 EEPROM	1	Chip select	3.23	From U401-3
	2	Serial data out	0	
	3	Write protect	3.23	
	4	Vss	GND	
	5	Serial data in	3.23	
	6	Serial clock	0	
	7	Hold	3.23	
	8	Vcc	3.23	
U404 Flash ROM	1	A11	3.06	
	2	A9	3.08	
	3	A8	3.05	
	4	A13	0.13	
	5	A14	0.31	
	6	NC	3.17	
	7	EN_WE	3.21	From U401-4
	8	Vcc	3.23	
	9	RESET	3.20	

Table 6-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U404 Flash ROM	10	A16	3.17	
	11	A15	0.30	
	12	A12	0.22	
	13	A7	3.03	
	14	A6	3.08	
	15	A5	3.06	
	16	A4	0	
	17	A3	0.24	
	18	A2	3.08	
	19	A1	3.05	
	20	A0	3.05	
	21	D0	0.69	
	22	D1	0.94	
	23	D2	1.08	
	24	GND	GND	
	25	D3	0.78	
	26	D4	0.59	
	27	D5	0.66	
	28	D6	0.67	
	29	D7	0.75	
	30	EN_CE	3.01	From U401-38
	31	A10	0.16	
	32	EN_OE	0	From U401-86
U451 ASFIC_CMP	1	VDD for analog circuits	3.00	
	2	DISC audio input	1.34	From U510
	3	Ground for analog circuits	GND	
	4	DACU output	0	
	5	DACR output	0	
	6	DACG output	2.38 (typ)	Power set (TX mode)
	7	VOX peak detector output	2.91	
	8	PLCAP for DC integrator	0.40	
	9	SQIN	0.01	
	10	Universal audio input/output	0	
	11	VDD for DACs	4.95	
	12	SQCAP	0	
	13	GCB2 general purpose output	0	Audio PA_EN (unsquelched)

Table 6-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U451 ASFIC_CMP	14	GCB1 general purpose output	0	
	15	GCB0 general purpose output	3.00	BW select (25 kHz mode)
	16	Squelch channel activity output	0	To U401-84
	17	Squelch detect digital output	0	To U401-83
	18	PL/low speed data I/O	1.50	
	19	High speed data I/O	3.00	
	20	Chip select	3.23	From U401-2
	21	Serial clock input	0	
	22	Serial data input	3.23	
	23	Ground for clock synthesizer	GND	
	24	Loop filter cap for clock syn	0.74	
	25	PLCAP2 for LS integrator	1.17	
	26	Not used	0	
	27	Vdd for clock synthesizer	3.00	
	28	Clock synthesizer output	1.70	
	29	1200 Hz ref for MDC decode	3.00	
	30	GNDDO	GND	
	31	Ground for digital circuits	GND	
	32	Vdd for analog switches	4.96	
	33	Vdd for digital circuits	3.00	
	34	16.8 MHz master clock input	1.54	
	35	GCB3 general purpose output	3.00	Internal MIC enable
	36	TX audio return from option	0	
	37	GCB4 general purpose output	0	
	38	GCB5 general purpose output	0	
	39	RX audio send to option	1.48	
	40	Modulation output	1.50	To U201-10
	41	RX audio out to power amp	1.51	
	42	Flat TX audio return from option	0.20	
	43	RX audio return to option	1.50	
	44	Flat TX audio send to option	1.50	
	45	Vdd for audio path I/O filters	3.00	
	46	Mic audio input	1.50	
	47	Ground for audio path I/O filters	GND	
	48	Ext mic audio input (not used)	0	

Notes:

Table 6-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U480 Dual Opamp	1	Unit 1 output	2.48	
	2	Unit 1 (-) input	2.48	
	3	Unit 1 (+) input	2.46	
	4	Ground	GND	
	5	Unit 2 (+) input	0.28	
	6	Unit 2 (-) input	0.29	
	7	Unit 2 output	0	
	8	Vcc	4.96	
U490 Audio Power Amp	1	Enable/shutdown	0.12	(Unsquelched)
	2	Bias reference	3.26	(Unsquelched)
	3	(+) input	3.26	(Unsquelched)
	4	(-) input	3.27	(Unsquelched)
	5	(-) output	3.25	(Unsquelched)
	6	Vcc	7.48	(Unsquelched)
	7	Ground	GND	
	8	(+) output	3.29	(Unsquelched)
U510 Dual Opamp	1	Unit 1 output	1.75	
	2	Unit 1 (-) input	1.56	
	3	Unit 1 (+) input	1.55	
	4	Ground	GND	
	5	Unit 2 (+) input	1.55	
	6	Unit 2 (-) input	1.56	
	7	Unit 2 output	1.38	
	8	Vcc	4.96	

1. All voltages are measured with a high-impedance digital voltmeter and expressed in volts DC relative to ground (0 V).
2. Voltages are measured with a DC input voltage of 7.50 + .02 volts DC applied to the battery connector (J301).
3. All voltages are measured in the squelched receive mode, unless otherwise indicated.
4. Voltages are identical for VHF and UHF models unless otherwise indicated.

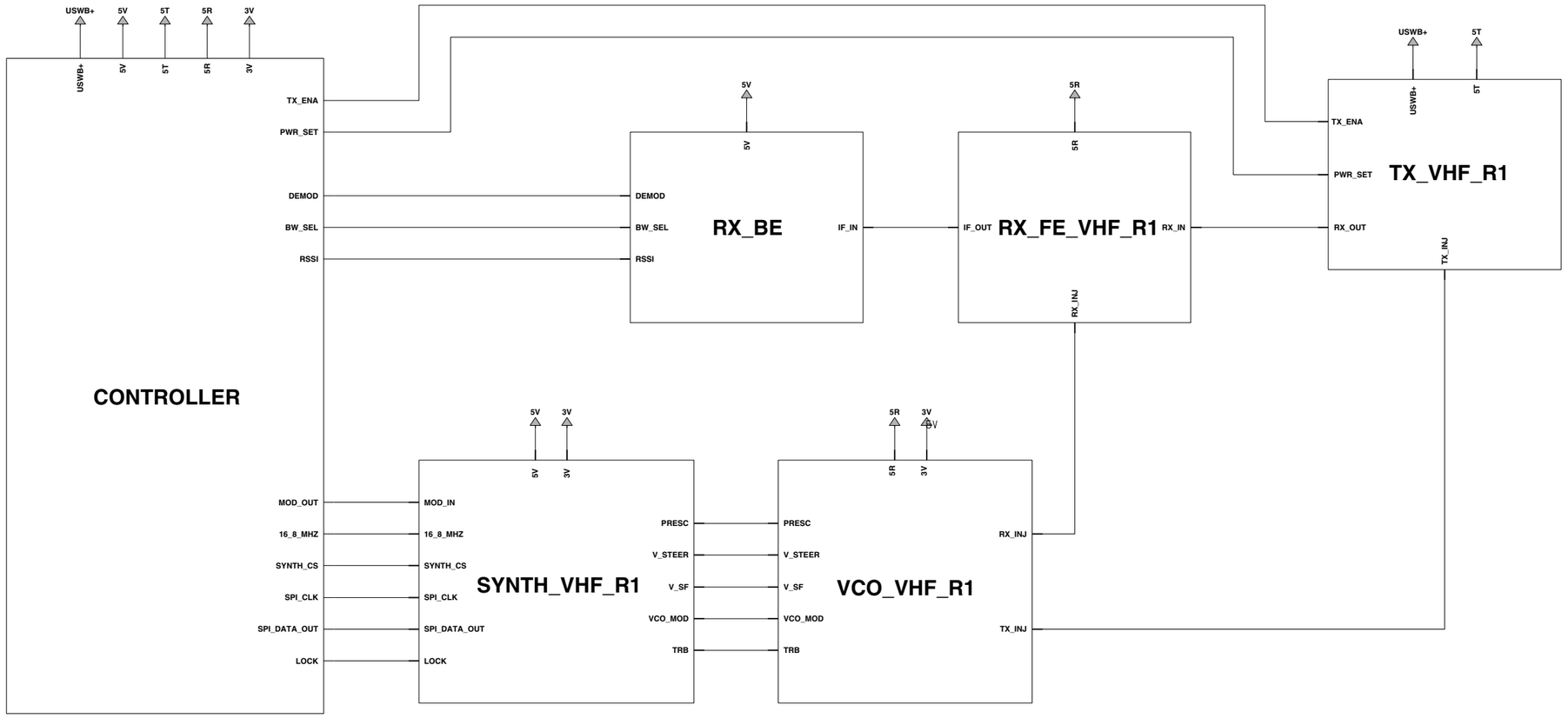


Figure 7-3. VHF (136-162 MHz) Radio Circuit Block Interconnect Diagram (8486769Z02-A)

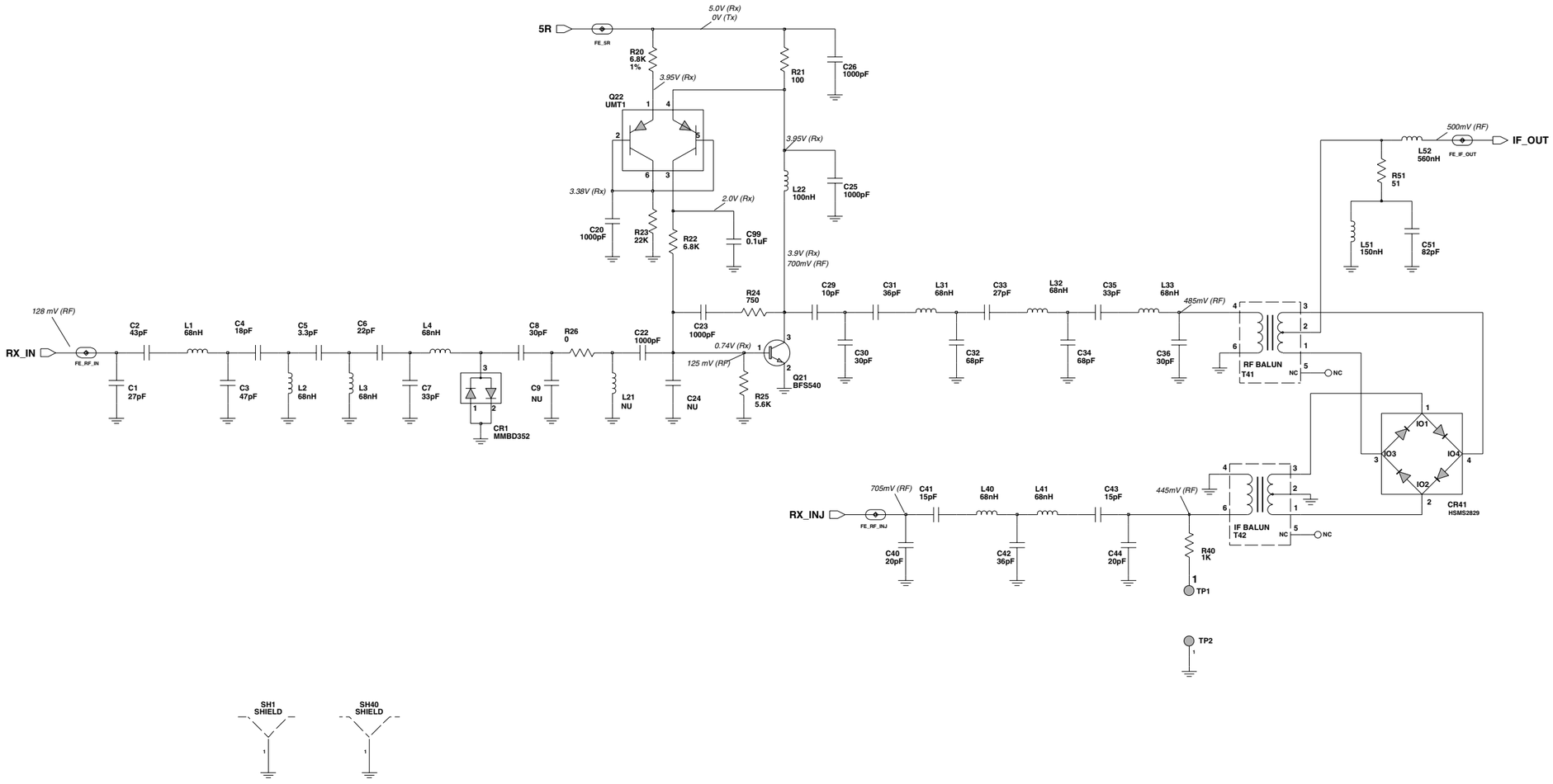


Figure 7-4. VHF (136-162 MHz) Receiver Front End Schematic Diagram (8486769Z02-A)

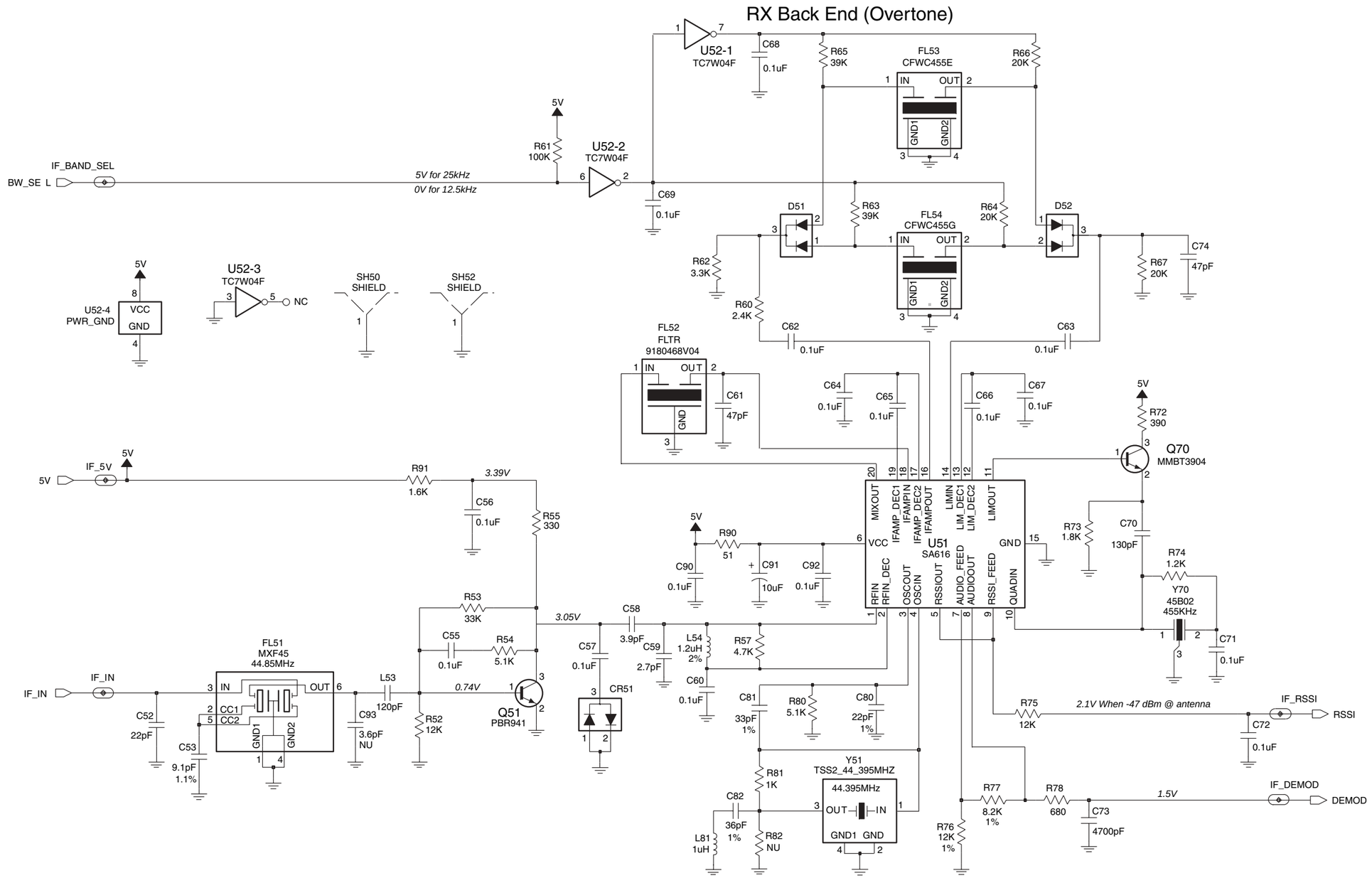
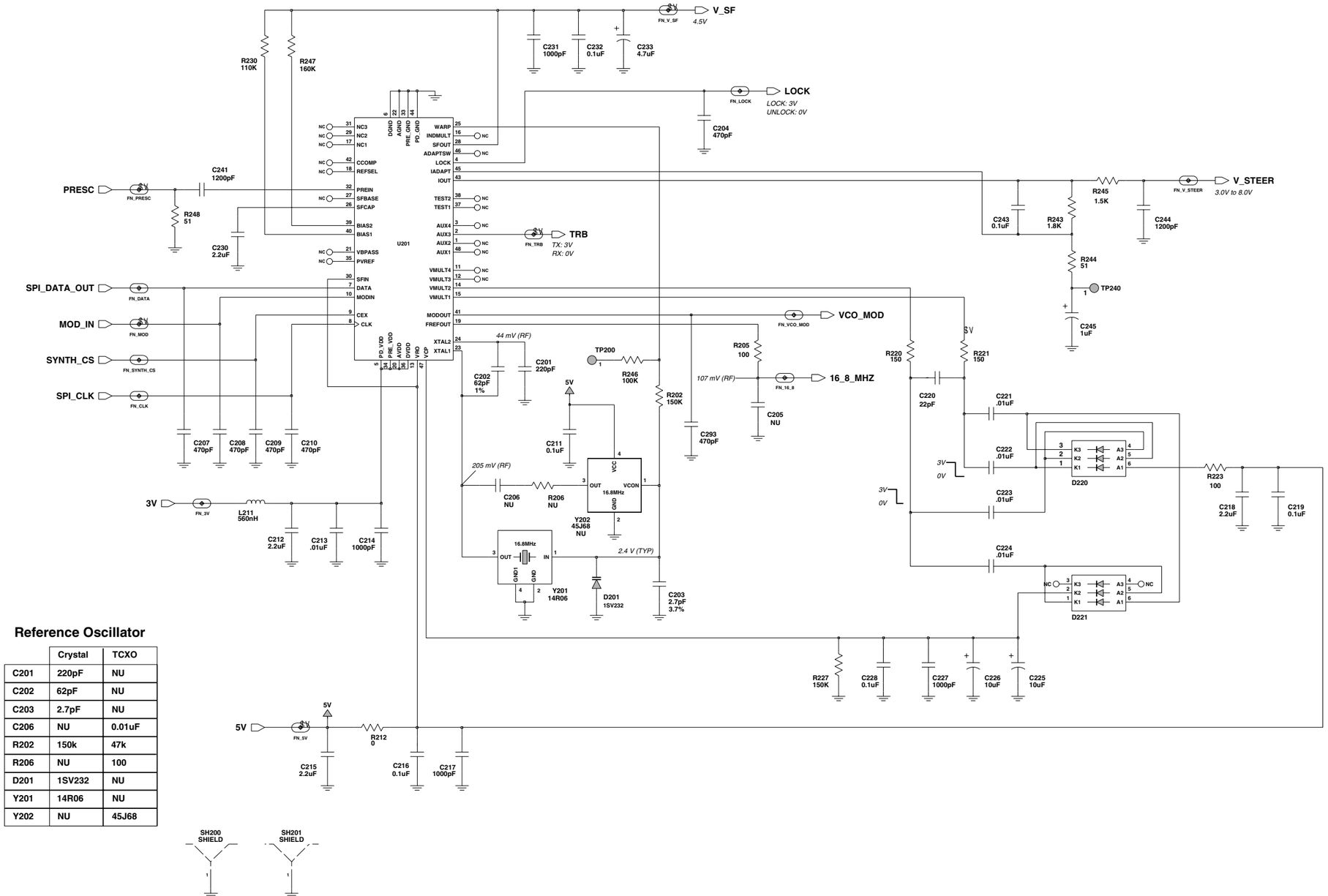


Figure 7-5. VHF (136-162 MHz) Receiver Back End Schematic Diagram (8486769Z02-A)



Reference Oscillator

	Crystal	TCXO
C201	220pF	NU
C202	62pF	NU
C203	2.7pF	NU
C206	NU	0.01uF
R202	150k	47k
R206	NU	100
D201	1SV232	NU
Y201	14R06	NU
Y202	NU	45J68

Figure 7-6. VHF (136-162 MHz) Synthesizer Schematic Diagram (8486769Z02-A)

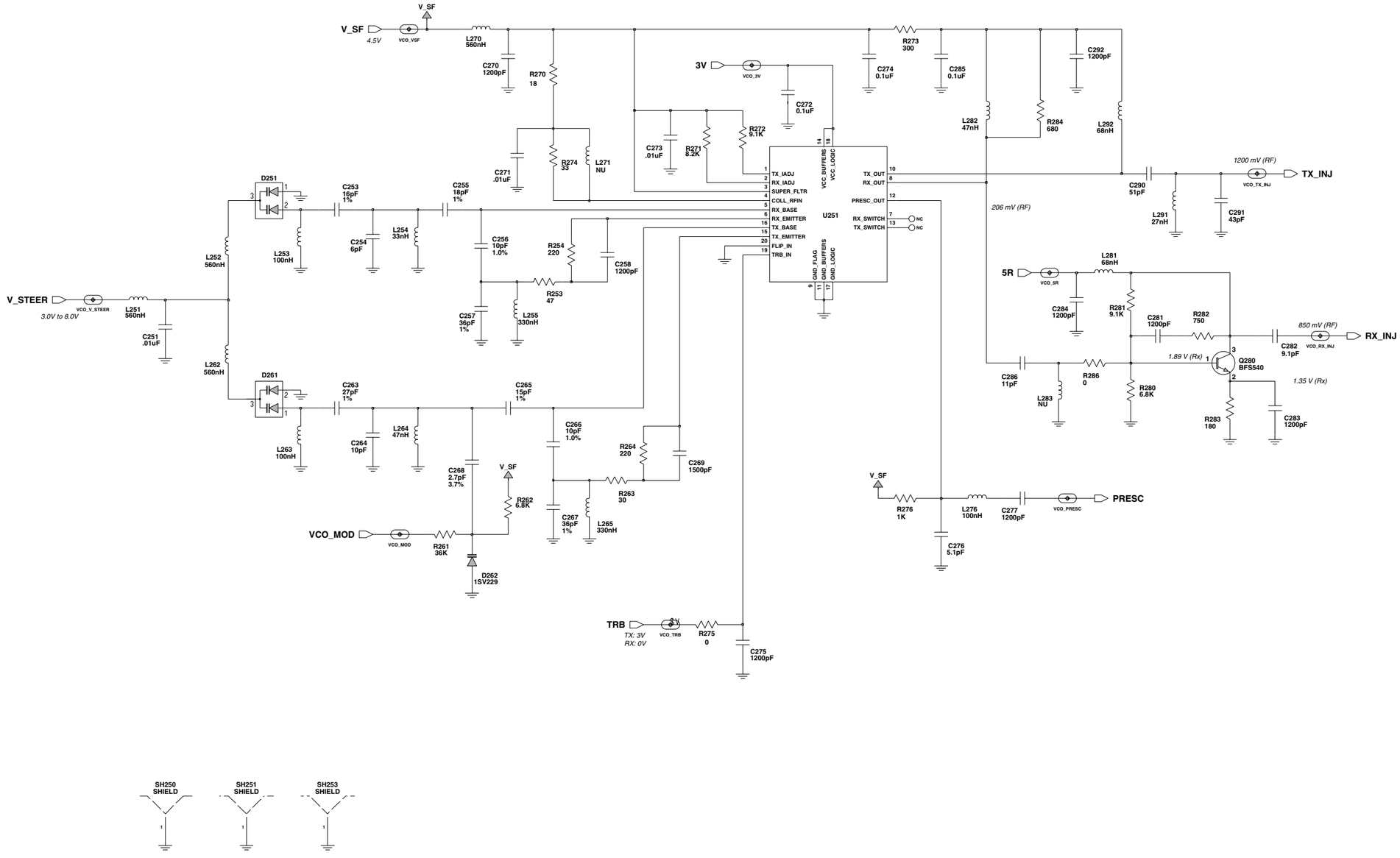


Figure 7-7. VHF (136-162 MHz) Voltage Controlled Oscillator Schematic Diagram (8486769Z02-A)

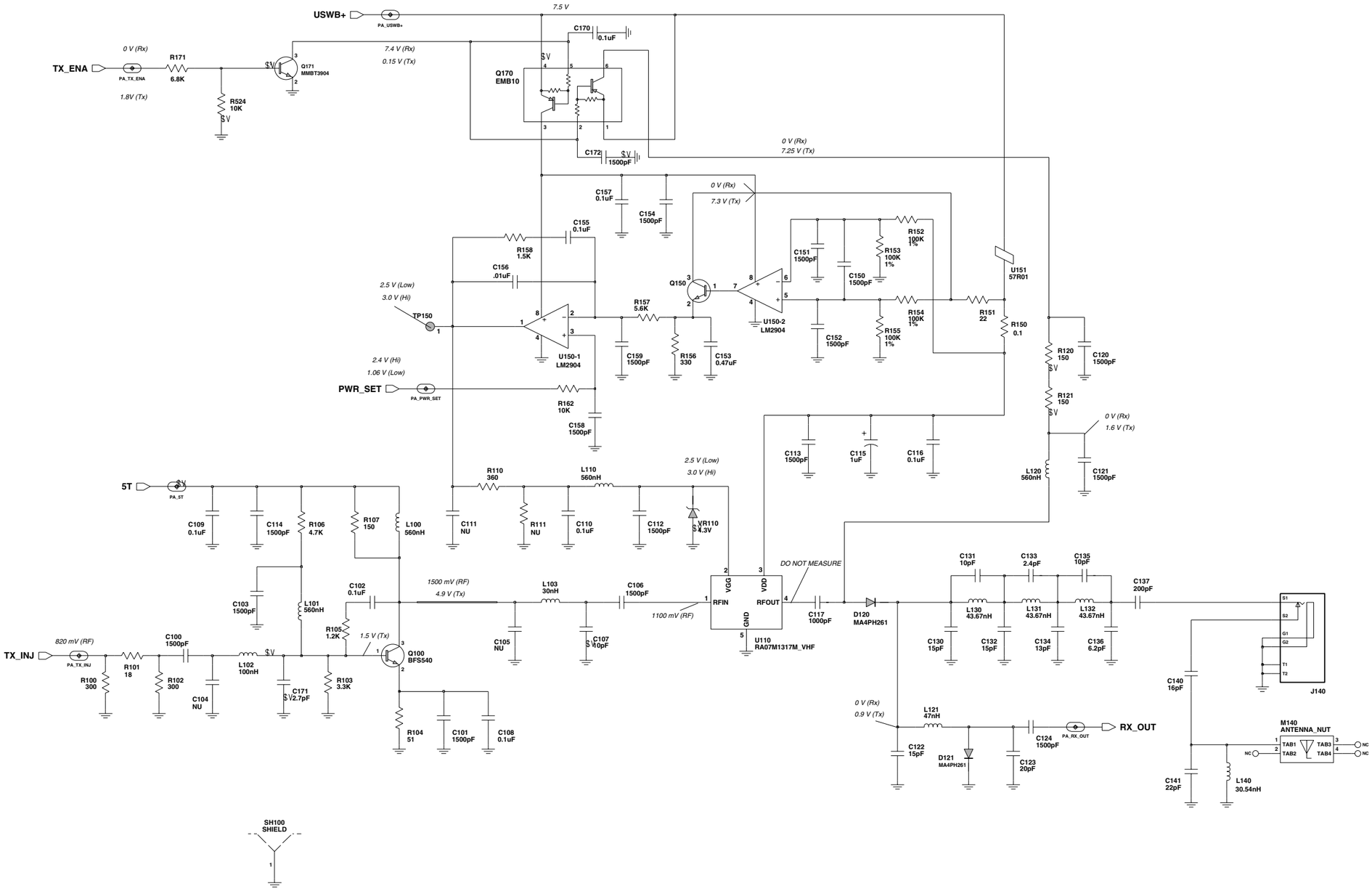


Figure 7-8. VHF (136-162 MHz) Transmitter and Power Control Schematic Diagram (8486769Z02-A)

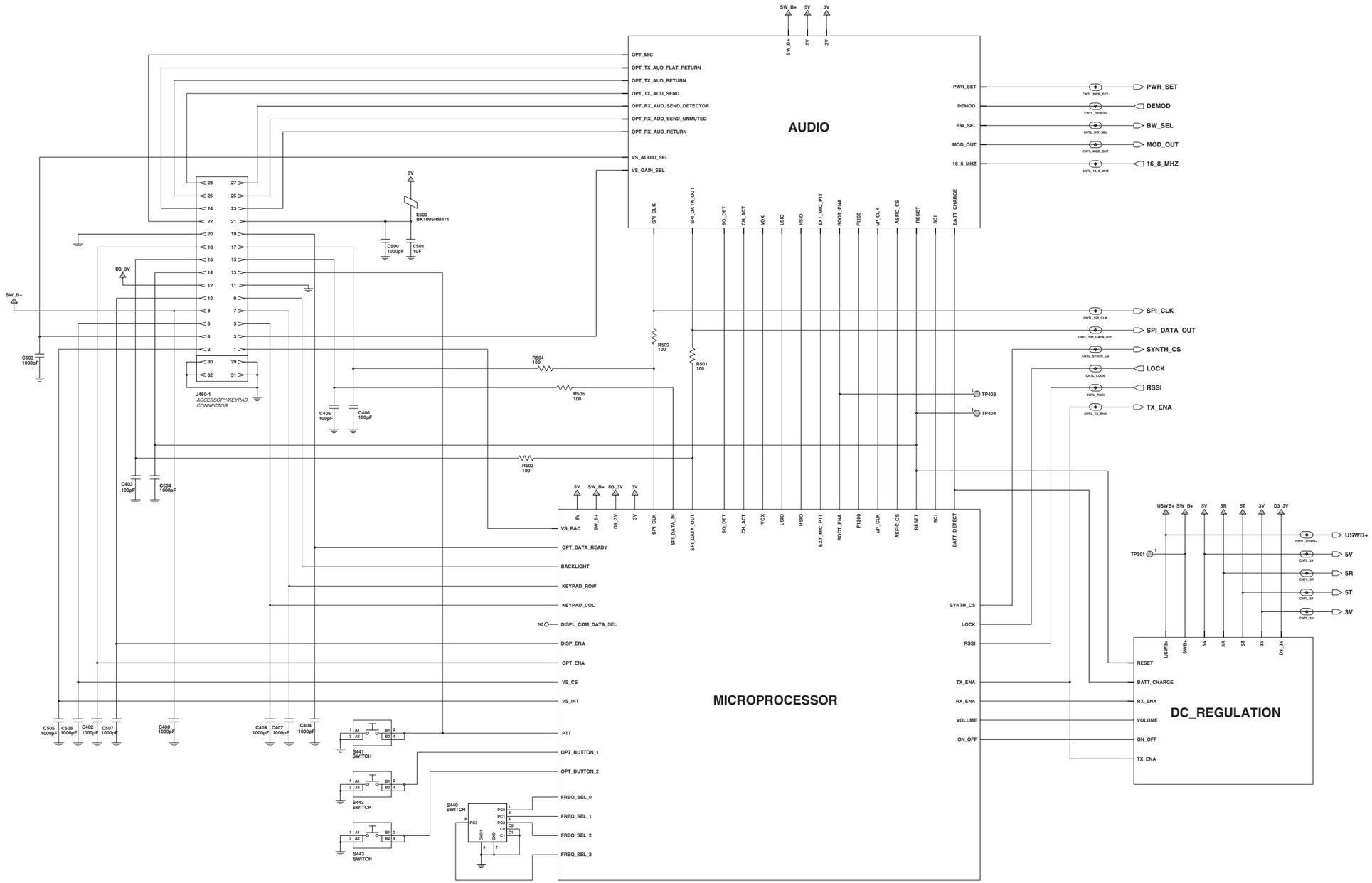


Figure 7-9. VHF (136-162 MHz) Controller Interconnect Schematic Diagram (8486769Z02-A)

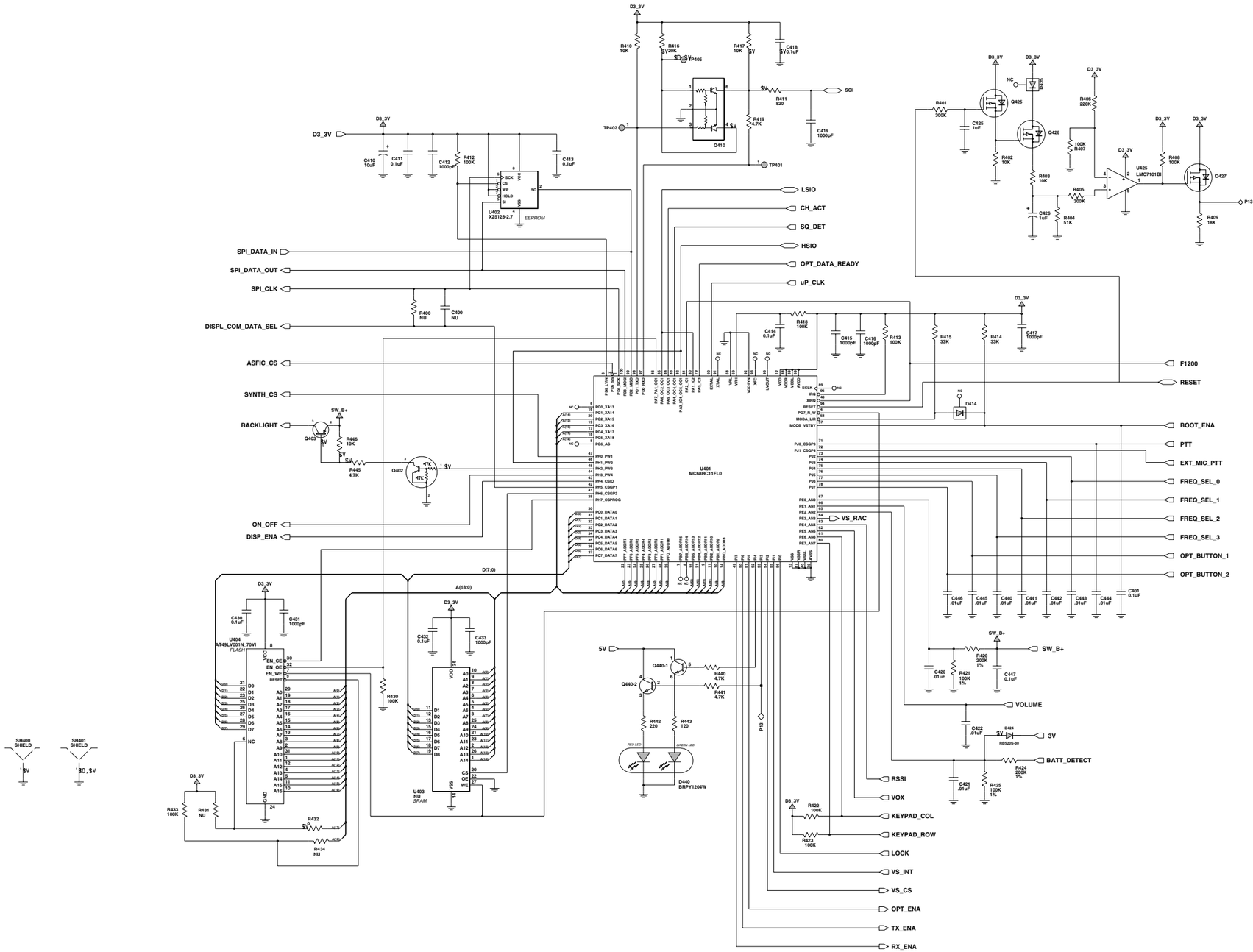


Figure 7-10. VHF (136-162 MHz) Microprocessor Circuitry Schematic Diagram (8486769Z02-A)

	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

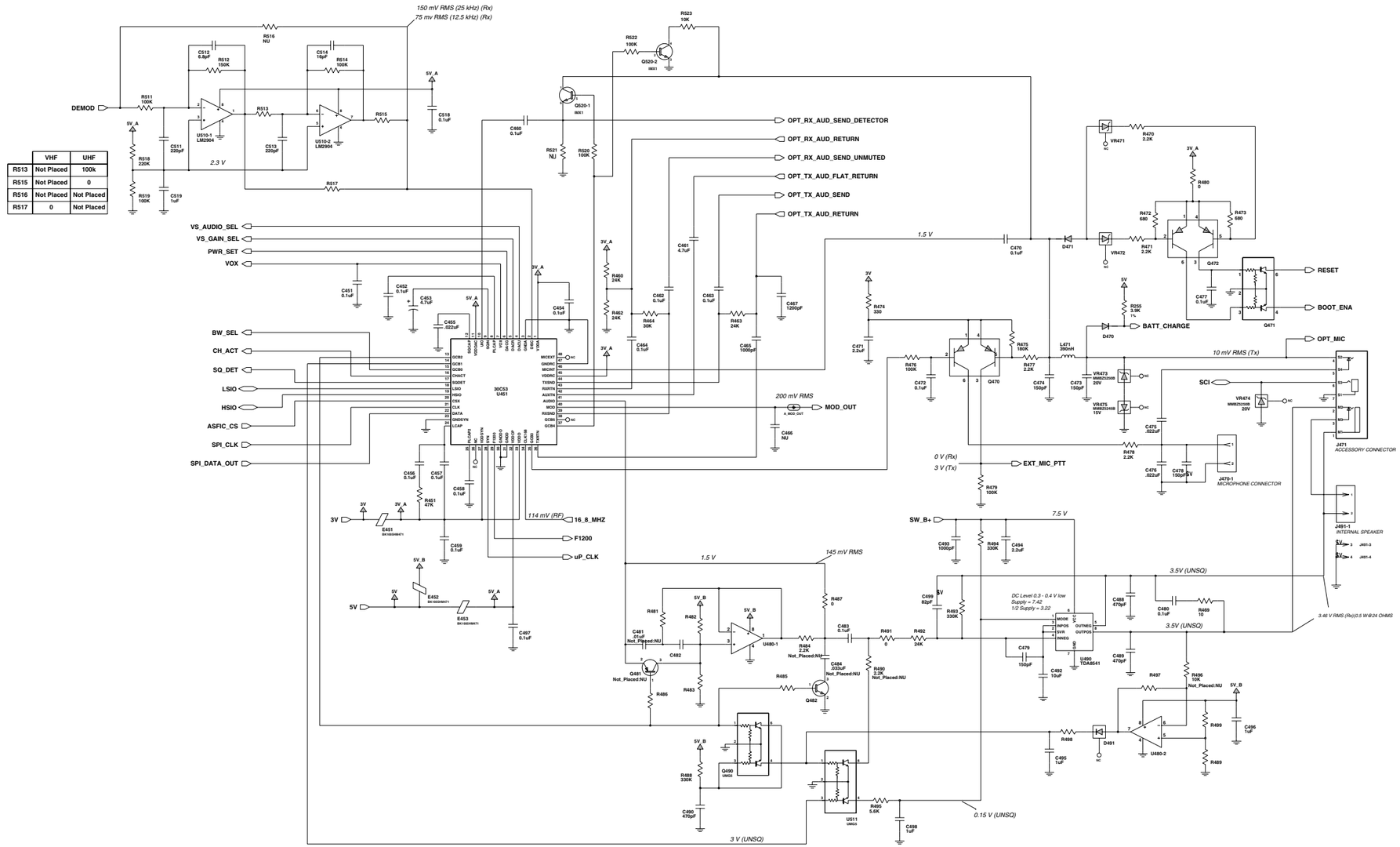


Figure 7-11. VHF (136-162 MHz) Audio Circuitry Schematic Diagram (8486769Z02-A)

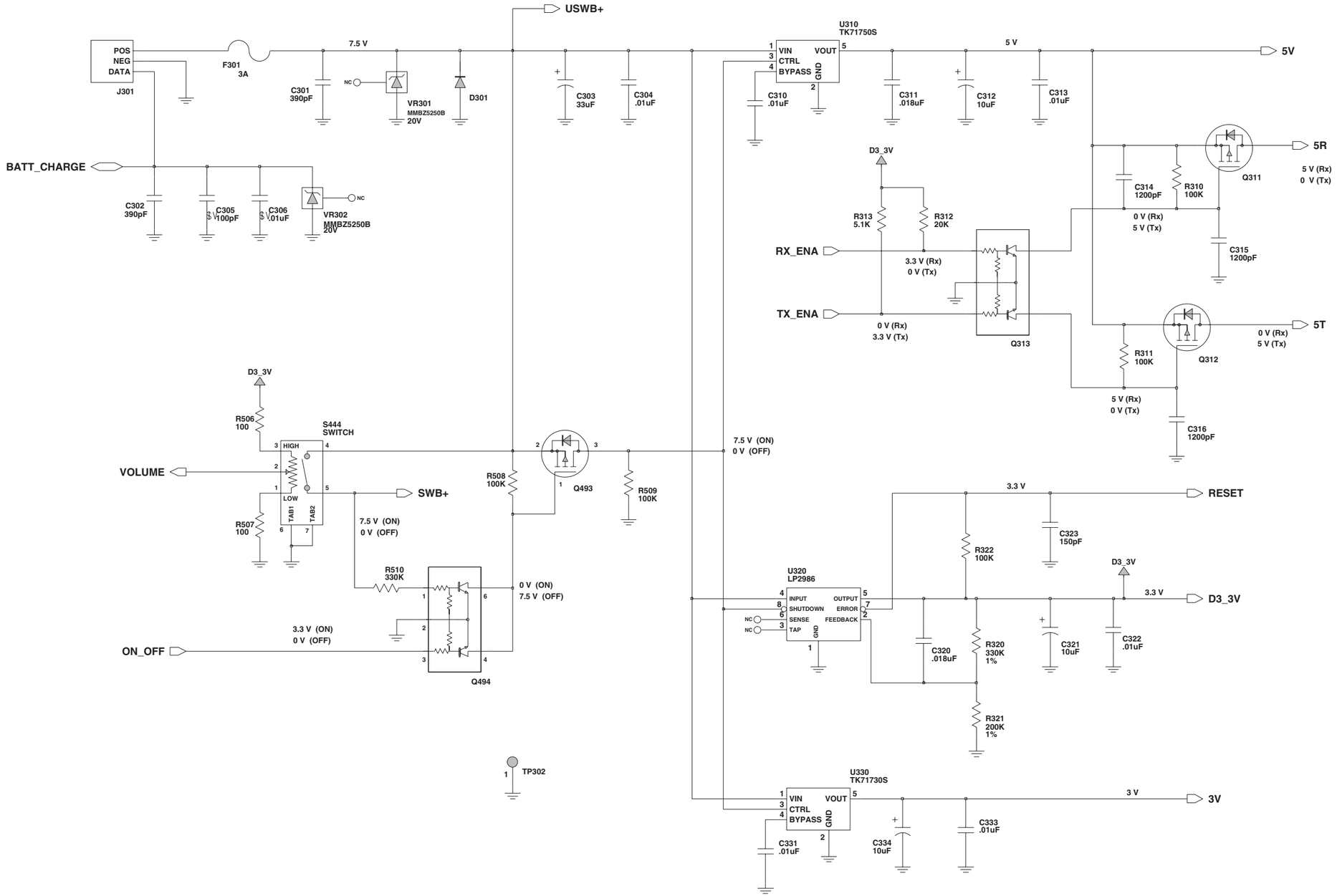


Figure 7-12. VHF (136-162 MHz) DC Regulation Schematic Diagram (8486769Z02-A)

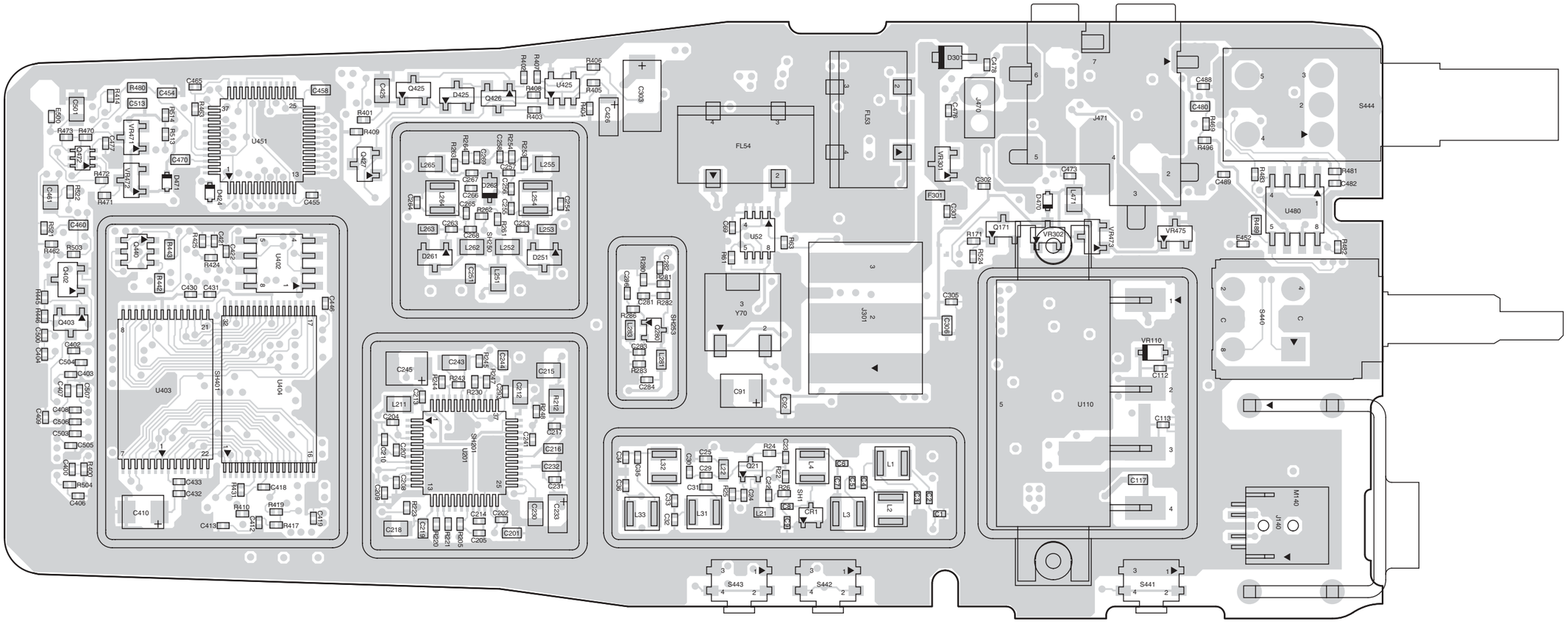


Figure 7-13. VHF (136-162 MHz) Board Top Side View (8486769Z02-A)

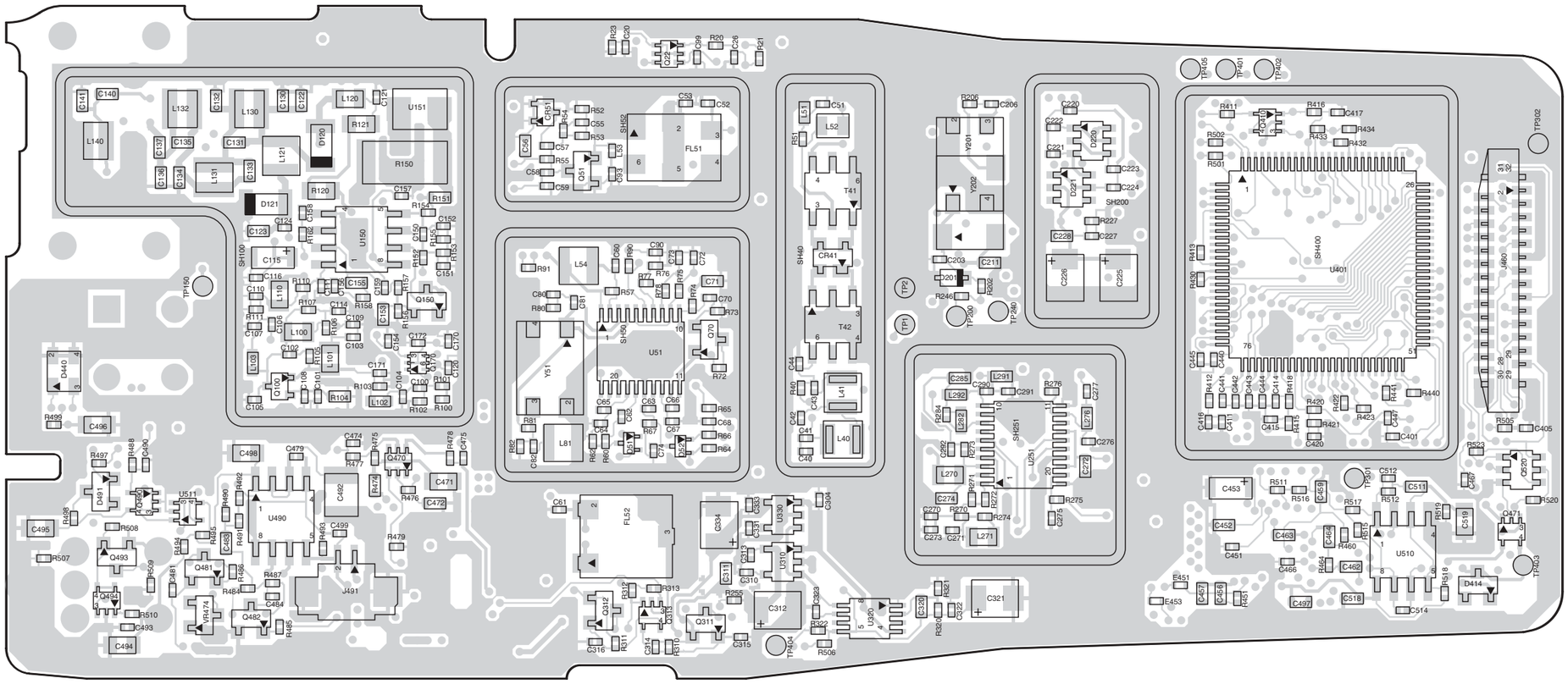


Figure 7-14. VHF (136-162 MHz) Board Bottom Side View (8486769Z02-A)

VHF (136-162 MHz) Radio Parts List (8486769Z02-A)

Circuit Ref	Motorola Part No.	Description
C1	2109445U43	CAP, 27pF
C2	2109445U48	CAP, 43pF
C3	2109445U49	CAP, 47pF
C4	2109445U39	CAP, 18pF
C5	2109445U15	CAP, 3.3pF
C6	2109445U41	CAP, 22pF
C7	2109445U45	CAP, 33pF
C8	2109445U44	CAP, 30pF
C9	Not_Placed	CAP, 24pF
C20	2113743L17	CAP, 1000pF
C22	2113743L17	CAP, 1000pF
C23	2113743L17	CAP, 1000pF
C24	Not_Placed	CAP, 6.2pF
C25	2113743L17	CAP, 1000pF
C26	2113743L17	CAP, 1000pF
C29	2109445U27	CAP, 10pF
C30	2109445U44	CAP, 30pF
C31	2109445U46	CAP, 36pF
C32	2109445U53	CAP, 68pF
C33	2109445U43	CAP, 27pF
C34	2109445U53	CAP, 68pF
C35	2109445U45	CAP, 33pF
C36	2109445U44	CAP, 30pF
C40	2109445U40	CAP, 20pF
C41	2109445U37	CAP, 15pF
C42	2109445U46	CAP, 36pF
C43	2109445U37	CAP, 15pF
C44	2109445U40	CAP, 20pF
C51	2113743N48	CAP, 82pF
C52	2109445U41	CAP, 22pF
C53	2109445U26	CAP, 9.1pF
C55	2113743M24	CAP, 0.1uF
C56	2113743E20	CAP, 0.1uF
C57	2113743M24	CAP, 0.1uF
C58	2113743N16	CAP, 3.9pF
C59	2113743N12	CAP, 2.7pF
C60	2113743M24	CAP, 0.1uF
C61	2113743N46	CAP, 68pF
C62	2113743M24	CAP, 0.1uF
C63	2113743M24	CAP, 0.1uF
C64	2113743M24	CAP, 0.1uF
C65	2113743M24	CAP, 0.1uF
C66	2113743M24	CAP, 0.1uF
C67	2113743M24	CAP, 0.1uF
C68	2113743M24	CAP, 0.1uF
C69	2113743M24	CAP, 0.1uF
C70	2113743N53	CAP, 130pF
C71	2113743E20	CAP, 0.1uF
C72	2113743M24	CAP, 0.1uF
C73	2113743L33	CAP, 4700pF
C74	2113743N42	CAP, 47pF
C80	2109445U41	CAP, 22pF
C81	2109445U45	CAP, 33pF
C82	2109445U46	CAP, 36pF
C90	2113743M24	CAP, 0.1uF
C91	2311049A57	CAP, 10uF
C92	2113743E20	CAP, 0.1uF
C93	Not_Placed	CAP, 3.6pF
C99	2113743M24	CAP, 0.1uF
C100	2113743L21	CAP, 1500pF
C101	2113743L21	CAP, 1500pF
C102	2113743M24	CAP, 0.1uF
C103	2113743L21	CAP, 1500pF
C104	Not_Placed	CAP, 27pF
C105	Not_Placed	CAP, 10pF
C106	2113743L21	CAP, 1500pF
C107	2113743N26	CAP, 10pF
C108	2113743M24	CAP, 0.1uF
C109	2113743M24	CAP, 0.1uF
C110	2113743M24	CAP, 0.1uF
C111	Not_Placed	CAP, 1500pF
C112	2113743L21	CAP, 1500pF
C113	2113743L21	CAP, 1500pF
C114	2113743L21	CAP, 1500pF
C115	2311049A07	CAP, 1uF
C116	2113743M24	CAP, 0.1uF
C117	2113741F25	CAP, 1000pF
C120	2113743L21	CAP, 1500pF
C121	2113743L21	CAP, 1500pF
C122	2113740F31	CAP, 15pF
C123	2113740F34	CAP, 20pF
C124	2113743L21	CAP, 1500pF
C130	2113740F31	CAP, 15pF
C131	2113740F27	CAP, 10pF
C132	2113740F31	CAP, 15pF
C133	2113740F12	CAP, 2.4pF
C134	2113740F30	CAP, 13pF
C135	2113740F27	CAP, 10pF
C136	2113740F22	CAP, 6.2pF
C137	2113740F58	CAP, 200pF
C140	2113740F32	CAP, 16pF
C141	2113740F35	CAP, 22pF
C150	2113743L21	CAP, 1500pF
C151	2113743L21	CAP, 1500pF
C152	2113743L21	CAP, 1500pF
C153	2113743K18	CAP, 0.47uF
C154	2113743L21	CAP, 1500pF
C155	2113743E20	CAP, 0.1uF
C156	2113743L41	CAP, .01uF
C157	2113743M24	CAP, 0.1uF
C158	2113743L21	CAP, 1500pF
C159	2113743L21	CAP, 1500pF
C170	2113743M24	CAP, 0.1uF
C171	2113743N12	CAP, 2.7pF
C172	2113743L21	CAP, 1500pF
C201	2113740F59	CAP, 220pF
C202	2109445U52	CAP, 62pF
C203	2109445U13	CAP, 2.7pF
C204	2113743L09	CAP, 470pF
C205	Not_Placed	CAP, 2.7pF
C206	Not_Placed	CAP, 1000pF
C207	2113743L09	CAP, 470pF
C208	2113743L09	CAP, 470pF
C209	2113743L09	CAP, 470pF
C210	2113743L09	CAP, 470pF
C211	2113743E20	CAP, 0.1uF
C212	2113743F18	CAP, 2.2uF
C213	2113743L41	CAP, .01uF
C214	2113743L17	CAP, 1000pF
C215	2113743F18	CAP, 2.2uF
C216	2113743E20	CAP, 0.1uF
C217	2113743L17	CAP, 1000pF
C218	2113743F18	CAP, 2.2uF
C219	2113743E20	CAP, 0.1uF
C220	2113743N34	CAP, 22pF
C221	2113743L41	CAP, .01uF
C222	2113743L41	CAP, .01uF
C223	2113743L41	CAP, .01uF
C224	2113743L41	CAP, .01uF
C225	2311049A57	CAP, 10uF
C226	2311049A57	CAP, 10uF
C227	2113743L17	CAP, 1000pF
C228	2113743E20	CAP, 0.1uF
C230	2113743F18	CAP, 2.2uF
C231	2113743L17	CAP, 1000pF
C232	2113743E20	CAP, 0.1uF
C233	2311049A56	CAP, 4.7uF
C241	2113743L19	CAP, 1200pF
C243	2113741M69	CAP, 0.1uF
C244	2113741F27	CAP, 1200pF
C245	2311049A08	CAP, 1uF
C251	2113741F49	CAP, .01uF
C253	2109445U38	CAP, 16pF
C254	2109445U30	CAP, 6pF
C255	2109445U39	CAP, 18pF
C256	2109445U27	CAP, 10pF
C257	2109445U46	CAP, 36pF
C258	2113743L19	CAP, 1200pF
C263	2109445U43	CAP, 27pF
C264	2109445U27	CAP, 10pF
C265	2109445U37	CAP, 15pF
C266	2109445U27	CAP, 10pF
C267	2109445U46	CAP, 36pF
C268	2109445U13	CAP, 2.7pF
C269	2113743L21	CAP, 1500pF
C270	2113743L19	CAP, 1200pF
C271	2113743L41	CAP, .01uF
C272	2113743E20	CAP, 0.1uF
C273	2113743L41	CAP, .01uF
C274	2113743E20	CAP, 0.1uF
C275	2113743L19	CAP, 1200pF
C276	2113743N19	CAP, 5.1pF
C277	2113743L19	CAP, 1200pF
C281	2113743L19	CAP, 1200pF
C282	2113743N25	CAP, 9.1pF
C283	2113743L19	CAP, 1200pF
C284	2113743L19	CAP, 1200pF
C285	2113743E20	CAP, 0.1uF
C286	2113743N27	CAP, 11pF
C290	2113743N43	CAP, 51pF
C291	2109445U48	CAP, 43pF
C292	2113743L19	CAP, 1200pF
C293	2113743L09	CAP, 470pF
C301	2113743L07	CAP, 390pF
C302	2113743L07	CAP, 390pF
C303	2311049A97	CAP, 33uF
C304	2113743L41	CAP, .01uF
C305	2113743N50	CAP, 100pF
C306	2113741F49	CAP, .01uF
C310	2113743L41	CAP, .01uF
C311	2113743E05	CAP, .018uF
C312	2311049A57	CAP, 10uF
C313	2113743L41	CAP, .01uF
C314	2113743L19	CAP, 1200pF
C315	2113743L19	CAP, 1200pF
C316	2113743L19	CAP, 1200pF
C320	2113743E05	CAP, .018uF
C321	2311049A57	CAP, 10uF
C322	2113743L41	CAP, .01uF
C323	2113743N54	CAP, 150pF
C331	2113743L41	CAP, .01uF
C333	2113743L41	CAP, .01uF
C334	2311049A57	CAP, 10uF
C400	Not_Placed	CAP, .022uF
C401	2113743M24	CAP, 0.1uF
C402	2113743L17	CAP, 1000pF
C403	2113743N50	CAP, 100pF
C404	2113743L17	CAP, 1000pF
C405	2113743N50	CAP, 100pF
C406	2113743N50	CAP, 100pF
C407	2113743L17	CAP, 1000pF
C408	2113743L17	CAP, 1000pF
C409	2113743L17	CAP, 1000pF

Circuit Ref	Motorola Part No.	Description
C410	2311049A57	CAP, 10uF
C411	2113743M24	CAP, 0.1uF
C412	2113743L17	CAP, 1000pF
C413	2113743M24	CAP, 0.1uF
C414	2113743M24	CAP, 0.1uF
C415	2113743L17	CAP, 1000pF
C416	2113743L17	CAP, 1000pF
C417	2113743L17	CAP, 1000pF
C418	2113743M24	CAP, 0.1uF
C419	2113743L17	CAP, 1000pF
C420	2113743L41	CAP, .01uF
C421	2113743L41	CAP, .01uF
C422	2113743L41	CAP, .01uF
C425	2113743F16	CAP, 1.0uF
C426	2311049A07	CAP, 1.0uF
C430	2113743M24	CAP, 0.1uF
C431	2113743L17	CAP, 1000pF
C432	2113743M24	CAP, 0.1uF
C433	2113743L17	CAP, 1000pF
C440	2113743L41	CAP, .01uF
C441	2113743L41	CAP, .01uF
C442	2113743L41	CAP, .01uF
C443	2113743L41	CAP, .01uF
C444	2113743L41	CAP, .01uF
C445	2113743L41	CAP, .01uF
C446	2113743L41	CAP, .01uF
C447	2113743M24	CAP, 0.1uF
C451	2113743M24	CAP, 0.1uF
C452	2113743E20	CAP, 0.1uF
C453	2311049A56	CAP, 4.7uF
C454	2113743E20	CAP, 0.1uF
C455	2113743L48	CAP, .022uF
C456	2113743E20	CAP, 0.1uF
C457	2113743E20	CAP, 0.1uF
C458	2113743E20	CAP, 0.1uF
C459	2113743E20	CAP, 0.1uF
C460	2113743E20	CAP, 0.1uF
C461	2113928C04	CAP, 4.7uF
C462	2113743E20	CAP, 0.1uF
C463	2113743E20	CAP, 0.1uF
C464	2113743E20	CAP, 0.1uF
C465	2113743L17	CAP, 1000pF
C466	Not_Placed	CAP, 470pF
C467	2113743L19	CAP, 1200pF
C470	2113743E20	CAP, 0.1uF
C471	2113743F18	CAP, 2.2uF
C472	2113743E20	CAP, 0.1uF
C473	2113743N54	CAP, 150pF
C474	2113743N54	CAP, 150pF
C475	2113743L48	CAP, .022uF
C476	2113743L48	CAP, .022uF
C477	2113743M24	CAP, 0.1uF
C478	2113743N54	CAP, 150pF
C479	2113743N54	CAP, 150pF
C480	2113743E20	CAP, 0.1uF
C481	Not_Placed	CAP, .01uF
C482	Not_Placed	CAP, .01uF
C483	2113928H02	CAP, 0.22uF
C484	Not_Placed	CAP, .033uF
C488	2113743L09	CAP, 470pF
C489	2113743L09	CAP, 470pF
C490	2113743L09	CAP, 470pF
C492	2113928J08	CAP, 10uF
C493	2113743L17	CAP, 1000pF
C494	2113743F18	CAP, 2.2uF
C495	2113743F16	CAP, 1uF
C496	2113743F16	CAP, 1uF
C497	2113743E20	CAP, 0.1uF
C498	2113743F16	CAP, 1uF
C499	2113743N40	CAP, 39pF
C500	2113743L17	CAP, 1000pF
C501	2113743F16	CAP, 1uF
C503	2113743L17	CAP, 1000pF
C504	2113743L17	CAP, 1000pF
C505	2113743L17	CAP, 1000pF
C506	2113743L17	CAP, 1000pF
C507	2113743L17	CAP, 1000pF
C511	2113740F59	CAP, 220pF
C512	2113743N22	CAP, 6.8pF
C513	2113740F59	CAP, 220pF
C514	2113743N31	CAP, 16pF
C518	2113743E20	CAP, 0.1uF
C519	2113743F16	CAP, 1uF
CR1	4813825A19	dual Schottky, MMBD352
CR41	4802246J04	quad ring diode, HSMS2829
CR51	4813825A19	dual Schottky, MMBD352
D51	4802245J97	dual silicon DAN235ETL
D52	4802245J97	dual silicon DAN235ETL
D120	4880973Z02	silicon PIN, MA4PH261
D121	4880973Z02	silicon PIN, MA4PH261
D201	4862824C03	varactor, 1SV232
D220	4802233J09	triple diode, IMN10
D221	4802233J09	triple diode, IMN10
D251	4805649Q13	dual varactor, 1SV228
D261	4805649Q13	dual varactor, 1SV228
D262	4862824C01	varactor, 1SV229
D301	4813833A19	silicon, reverse polarity, MBRM120ET3
D414	4805129M41	Schottky, MMBD501
D424	4809924D18	Schottky, RB520S-30
D425	4805129M41	SOT SMBD1022 RH29M19 LH
D440	4805729G49	dual LED red/green, BRPY1204W
D470	4809924D18	Schottky, RB520S-30
D471	4809924D18	Schottky, RB520S-30
D491	Not_Placed	Schottky, MMBD501
E451	2480640Z01	bead, BK1005HM471
E452	2480640Z01	bead, BK1005HM471
E453	2480640Z01	bead, BK1005HM471
E500	2480640Z01	bead, BK1005HM471
F301	6580542Z01	fuse, 3 amp
FL51	9186801Z01	OSC,XTAL,,44.85MHZ
FL52	9180468V04	4-pole ceramic filter, 455 kHz, CFU455F
FL53	9180469V05	6-pole ceramic, filter, 455 kHz, CFWC455E
FL54	9180469V03	6-pole ceramic filter, 455 kHz, CFWC455G
J140	0986428Z01	connector, external antenna
J301	0986565Z01	battery contact assembly
J460	Not_Placed	CONN,ZIF,28 CONT TIN CBL
J470	0985818A01	connector, 2-pin internal mic
J471	0980683Z03	connector, 2.5 / 3.5mm, accessories
J491	2809926G01	connector, 2-pin internal speaker
L1	2413923C09	IDCTR, 68nH
L2	2413923C09	IDCTR, 68nH
L3	2413923C09	IDCTR, 68nH
L4	2413923C09	IDCTR, 68nH
L21	Not_Placed	IDCTR, 39nH
L22	2413926N24	IDCTR, 100nH
L31	2413923C09	IDCTR, 68nH
L32	2413923C09	IDCTR, 68nH
L33	2413923C09	IDCTR, 68nH
L40	2413923C09	IDCTR, 68nH
L41	2413923C09	IDCTR, 68nH
L51	2413926N26	IDCTR, 150nH
L52	2462587V43	IDCTR, 560nH
L53	2113743N52	CAP, 120pF
L54	2413923A25	IDCTR, 1.2uH
L81	2413923A19	IDCTR, 1uH
L100	2413926K32	IDCTR, 560nH
L101	2413926K32	IDCTR, 560nH
L102	2409377M17	IDCTR, 100nH
L103	2409377M31	IDCTR, 30nH
L110	2413926K32	IDCTR, 560nH
L120	2413926K32	IDCTR, 560nH
L121	2462587N49	IDCTR, 47nH
L130	2479990N01	IDCTR, 43.67nH
L131	2479990N01	IDCTR, 43.67nH
L132	2479990N01	IDCTR, 43.67nH
L140	2479990M01	IDCTR, 30.54nH
L211	2413926K32	IDCTR, 560nH
L251	2413926K32	IDCTR, 560nH
L252	2413926K32	IDCTR, 560nH
L253	2409377M17	IDCTR, 100nH
L254	2413923C05	IDCTR, 33nH
L255	2413926K29	IDCTR, 330nH
L262	2413926K32	IDCTR, 560nH
L263	2409377M17	IDCTR, 100nH
L264	2413923C07	IDCTR, 47nH
L265	2413926K29	IDCTR, 330nH
L270	2413926K32	IDCTR, 560nH
L271	Not_Placed	IDCTR, 560nH
L276	2413926N24	IDCTR, 100nH
L281	2413926N22	IDCTR, 68nH
L282	2413926N20	IDCTR, 47nH
L283	Not_Placed	IDCTR, 270nH
L291	2413926N17	IDCTR, 27nH
L292	2413926N22	IDCTR, 68nH
L471	2413926K30	IDCTR, 390nH
M140	0286427Z01	antenna nut
Q21	4802245J95	silicon NPN, BFS540
Q22	4805723X02	dFcual silicon PNP, UMT1
Q51	4802197J95	silicon NPN, PBR941
Q70	4880214G02	silicon NPN, MMBT3904
Q100	4802245J95	silicon NPN, BFS540
Q150	4880214G02	silicon NPN, MMBT3904
Q170	4809939C34	dual silicon PNP, EMB10
Q171	4880214G02	silicon NPN, MMBT3904
Q280	4802245J95	silicon NPN, BFS540
Q311	4809579E18	P-channel MOSFET, TP0101T
Q312	4809579E18	P-channel MOSFET, TP0101T
Q313	4802245J54	dual digit NPN, UMG5
Q402	4880048M01	digital NPN, DTC144EKA
Q403	4813824A17	silicon PNP, MMBT3906
Q410	4802245J54	dual digit NPN, UMG5
Q425	4809579E18	TSTR MOSFET P-CHAN TP010IT
Q426	4809579E18	TSTR MOSFET P-CHAN TP010IT
Q427	4809579E18	TSTR MOSFET P-CHAN TP010IT
Q440	5180159R01	dual NPN, IMX1
Q470	4805723X02	dual silicon PNP, UMT1
Q471	4802245J54	dual digital NPN, UMG5
Q472	4805723X02	dual silicon PNP, UMT1
Q481	Not_Placed	MMBT3906
Q482	Not_Placed	MMBT3904
Q490	4802245J54	dual digital NPN, UMG5
Q493	4809579E18	P-channel MOSFET, TP0101T
Q494	4802245J54	dual digital NPN, UMG5

Circuit Ref	Motorola Part No.	Description
Q520	5180159R01	dual NPN, IMX1
R20	0662057U97	RES, 6.8K
R21	0662057M50	RES, 100
R22	0662057M94	RES, 6.8K
R23	0662057V11	RES, 22K
R24	0662057M71	RES, 750
R25	0662057M92	RES, 5.6K
R26	0662057M01	RES, 0
R40	0662057M74	RES, 1K
R51	0662057M43	RES, 51
R52	0662057N01	RES, 12K
R53	0662057N11	RES, 33K
R54	0662057M91	RES, 5.1K
R55	0662057M62	RES, 330
R57	0662057M90	RES, 4.7K
R60	0662057M83	RES, 2.4K
R61	0662057N23	RES, 100K
R62	0662057M86	RES, 3.3K
R63	0662057N13	RES, 39K
R64	0662057N06	RES, 20K
R65	0662057N13	RES, 39K
R66	0662057N06	RES, 20K
R67	0662057N06	RES, 20K
R72	0662057M64	RES, 390
R73	0662057M80	RES, 1.8K
R74	0662057M76	RES, 1.2K
R75	0662057N01	RES, 12K
R76	0662057V04	RES, 12K
R77	0662057U99	RES, 8.2K
R78	0662057M70	RES, 680
R80	0662057M91	RES, 5.1K
R81	0662057M74	RES, 1K
R82	Not_Placed	RES, 0
R90	0662057M43	RES, 51
R91	0662057M79	RES, 1.6K
R100	0662057M61	RES, 300
R101	0662057M32	RES, 18
R102	0662057M61	RES, 300
R103	0662057M86	RES, 3.3K
R104	0662057A18	RES, 51
R105	0662057M76	RES, 1.2K
R106	0662057M90	RES, 4.7K
R107	0662057M54	RES, 150
R110	0662057M63	RES, 360
R111	Not_Placed	RES, 2.7K
R120	0662057C55	RES, 150
R121	0662057C55	RES, 150
R150	0680539Z01	RES, 0.1
R151	0662057A09	RES, 22
R152	0662057V27	RES, 100K
R153	0662057V27	RES, 100K
R154	0662057V27	RES, 100K
R155	0662057V27	RES, 100K
R156	0662057M62	RES, 330
R157	0662057M92	RES, 5.6K
R158	0662057M78	RES, 1.5K
R162	0662057M98	RES, 10K
R171	0662057M94	RES, 6.8K
R202	0662057N27	RES, 150K
R205	0662057M50	RES, 100
R206	Not_Placed	RES, 100
R212	0662057C01	RES, 0
R220	0662057M54	RES, 150
R221	0662057M54	RES, 150
R223	0662057M50	RES, 100
R227	0662057N27	RES, 150K
R230	0662057N24	RES, 110K
R243	0662057M80	RES, 180
R244	0662057M43	RES, 51
R245	0662057M78	RES, 1.5K
R246	0662057N23	RES, 100K
R247	0662057N28	RES, 160K
R248	0662057M43	RES, 51
R253	0662057M42	RES, 47
R254	0662057M58	RES, 220
R255	0662057U91	RES, 3.9K
R261	0662057N12	RES, 36K
R262	0662057M94	RES, 6.8K
R263	0662057M37	RES, 30
R264	0662057M58	RES, 220
R270	0662057M32	RES, 18
R271	0662057M96	RES, 8.2K
R272	0662057M97	RES, 9.1K
R273	0662057M61	RES, 300
R274	0662057M38	RES, 33
R275	0662057M01	RES, 0
R276	0662057M74	RES, 1K
R280	0662057M94	RES, 6.8K
R281	0662057M97	RES, 9.1K
R282	0662057M71	RES, 750
R283	0662057M56	RES, 180
R284	0662057M70	RES, 680
R286	0662057M01	RES, 0
R310	0662057N23	RES, 100K
R311	0662057N23	RES, 100K
R312	0662057N06	RES, 20K
R313	0662057M91	RES, 5.1K
R320	0662057V43	RES, 330K
R321	0662057V35	RES, 200K
R322	0662057N23	RES, 100K
R400	Not_Placed	RES, 100K
R401	0662057N34	RES, 300K
R402	0662057M98	RES, 10K
R403	0662057M98	RES, 10K
R404	0662057N16	RES, 51K
R405	0662057N34	RES, 300K
R406	0662057N31	RES, 220K
R407	0662057N23	RES, 100K
R408	0662057N23	RES, 100K
R409	0662057N05	RES, 18K
R410	0662057M98	RES, 10K
R411	0662057M72	RES, 820
R412	0662057N23	RES, 100K
R413	0662057N23	RES, 100K
R414	0662057N11	RES, 33K
R415	0662057N11	RES, 33K
R416	0662057N06	RES, 20K
R417	0662057M98	RES, 10K
R418	0662057N23	RES, 100K
R419	0662057M90	RES, 4.7K
R420	0662057V35	RES, 200K
R421	0662057V27	RES, 100K
R422	0662057N23	RES, 100K
R423	0662057N23	RES, 100K
R424	0662057V35	RES, 200K
R425	0662057V27	RES, 100K
R430	0662057N23	RES, 100K
R431	Not_Placed	RES, 100K
R432	0662057M01	RES, 0
R433	0662057N23	RES, 100K
R434	Not_Placed	RES, 100K
R440	0662057M90	RES, 4.7K
R441	0662057M90	RES, 4.7K
R442	0662057A33	RES, 220
R443	0662057A27	RES, 120
R445	0662057M90	RES, 4.7K
R446	0662057M98	RES, 10K
R451	0662057N15	RES, 47K
R460	0662057N08	RES, 24K
R462	0662057N08	RES, 24K
R463	0662057N08	RES, 24K
R464	0662057N10	RES, 30K
R469	0662057M26	RES, 10
R470	0662057M82	RES, 2.2K
R471	0662057M82	RES, 2.2K
R472	0662057M70	RES, 680
R473	0662057M70	RES, 680
R474	0662057A37	RES, 330
R475	0662057N29	RES, 180K
R476	0662057N23	RES, 100K
R477	0662057M82	RES, 2.2K
R478	0662057M82	RES, 2.2K
R479	0662057N23	RES, 100K
R480	0662057B47	RES, 0
R481	Not_Placed	RES, 100K
R482	Not_Placed	RES, 330K
R483	Not_Placed	RES, 150K
R484	Not_Placed	RES, 2.2K
R485	Not_Placed	RES, 100K
R486	Not_Placed	RES, 100K
R487	0662057M01	RES, 0
R488	0662057N35	RES, 330K
R489	Not_Placed	RES, 91K
R490	Not_Placed	RES, 2.2K
R491	0662057M01	RES, 0
R492	0662057N08	RES, 24K
R493	0662057N35	RES, 330K
R494	0662057V43	RES, 330K
R495	0662057M92	RES, 5.6K
R496	Not_Placed	RES, 10K
R497	Not_Placed	RES, 1MEG
R498	Not_Placed	RES, 47K
R499	Not_Placed	RES, 270K
R501	0662057M50	RES, 100
R502	0662057M50	RES, 100
R503	0662057M50	RES, 100
R504	0662057M50	RES, 100
R505	0662057M50	RES, 100
R506	0662057M50	RES, 100
R507	0662057M50	RES, 100
R508	0662057N23	RES, 100K
R509	0662057N23	RES, 100K
R510	0662057N35	RES, 330K
R511	0662057N23	RES, 100K
R512	0662057N27	RES, 150K
R513	Not_Placed	RES, 100K
R514	0662057N23	RES, 100K
R515	Not_Placed	RES, 0
R516	Not_Placed	RES, 0
R517	0662057M01	RES, 0
R518	0662057N31	RES, 220K
R519	0662057N23	RES, 100K
R520	0662057N23	RES, 100K
R521	Not_Placed	RES, 100K
R522	0662057N23	RES, 100K
R523	0662057M98	RES, 10K
R524	0662057M98	RES, 10K
S440	4080710Z22 & 4080710Z15	switch, rotary, 16 and 32/64 - channel select
S441	4070354A01	pushbutton switch, PTT
S442	4070354A01	pushbutton switch, side option (lower)
S443	4070354A01	pushbutton switch, side option (upper)

Circuit Ref	Motorola Part No.	Description
S444	1880619Z02	switch, rotary on-off, with 10K volume control
SH1	2686421Z01	shield, comp side, RF front end
SH40	2686419Z01	shield, solder side, first mixer
SH50	2686423Z01	shield, solder side, IFIC and 2nd LO crystal
SH52	2686424Z01	shield, solder side, high IF crystal filter
SH100	2686418Z01	shield, solder side, transmitter
SH200	2686424Z01	shield, solder side, synthesizer charge pump
SH201	2686423Z01	shield, comp side, synthesizer
SH250	2686425Z01	shield, comp side, VCO tank circuits
SH251	2686425Z01	shield, solder side, VCOBIC
SH253	2686422Z01	shield, comp side, VCO RX injection buffer
SH400	2686420Z02	shield, solder side, microprocessor
SH401	2686420Z01	shield, comp side, memory
T41	2580541Z02	transformer, balun
T42	2580541Z02	transformer, balun
U51	5186144B01	receiver system (IFIC), SA616
U52	5109522E10	triple inverter, TC7W04F
U110	0186438Z01	transmitter PA module, RA07M1317M_VHF
U150	5113818A01	dual op amp, LM2904
U151	2484657R01	bead, 57R01
U201*	5185963A27	frequency synthesizer, 63A27
U251	5105750U54	VCO/buffer, 50U54
U310	5102478J01	5 V voltage regulator, TK71750S
U320	5185963A55	adjustable voltage regulator w/ reset, LP2986
U330	5102479J01	3 V voltage regulator, TK71730S
U403	Not_Placed	SRM2B256
U425	5162852A09	LOW PWR OP AMP W/RAIL TO RAIL
U451	5185130C53	audio filter (ASFIC.cmp), 30C53
U480	Not_Placed	LM2904
U490	5108858K99	audio power amplifier, TDA8541
U510	5113818A01	dual op amp, LM2904
U511	4802245J54	dual digital NPN, UMG5
U401*	5102226J56	microprocessor, MC68HC11FL0
U402*	5102463J64	serial EEPROM 16Kx8, X25128-2.7
U404*	5102480J01	Flash ROM 128Kx8, AT49LV001N_70VI
VR110	4813830A82	zener diode, 4.3 V, MM3Z4V3T1
VR301	4813830A33	zener diode, 20 V, MMBZ5250B
VR302	4813830A33	zener diode, 20 V, MMBZ5250B
VR471	4813830A18	zener diode, 6.8 V, MMBZ5235B
VR472	4813830A09	zener diode, 3.3 V, MMBZ5226B
VR473	4813830A33	zener diode, 20 V, MMBZ5250B
VR474	4813830A33	zener diode, 20 V, MMBZ5250B
VR475	4880140L20	zener diode, 15 V, MMBZ5245B
Y51	4802245J84	crystal, 44.395 MHz
Y70	9186145B02	ceramic discriminator, 455 kHz, 45B02
Y201*	4880114R06	crystal, 16.8 MHz, 14R06
Y202	Not_Placed	45J68

* Motorola Depot Servicing only

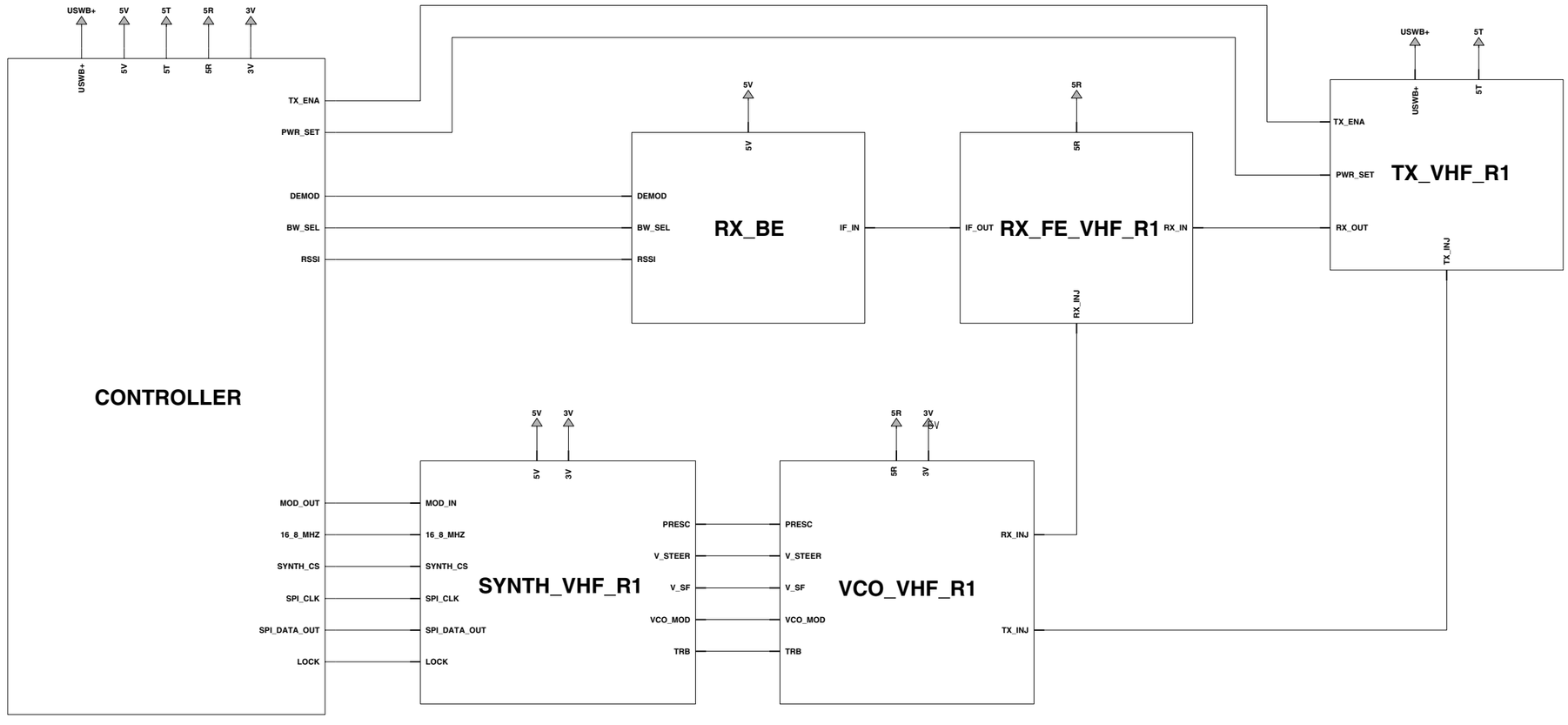


Figure 7-15. VHF (136-162 MHz) Radio Circuit Block Interconnect Diagram (8486769Z04-C)

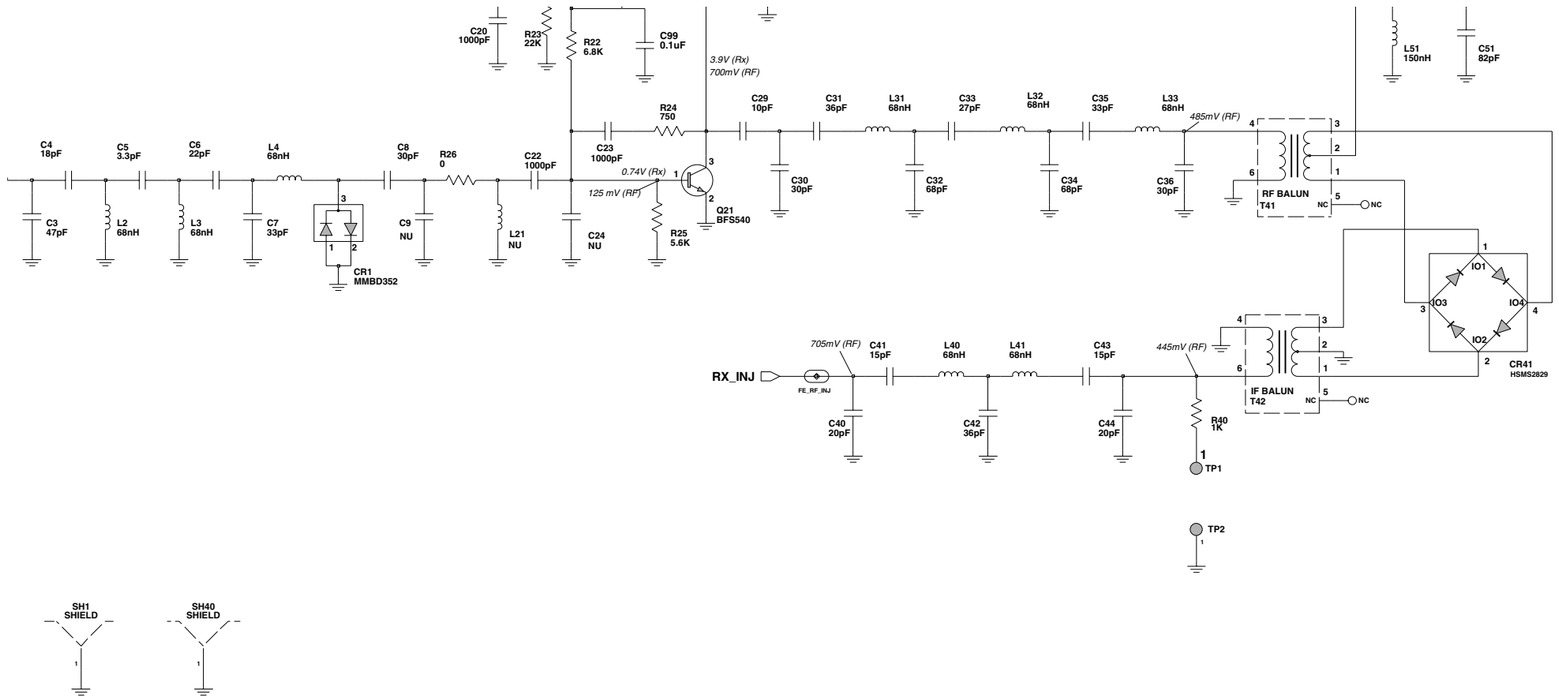


Figure 7-16. VHF (136-162 MHz) Receiver Front End Schematic Diagram (8486769Z04-C)

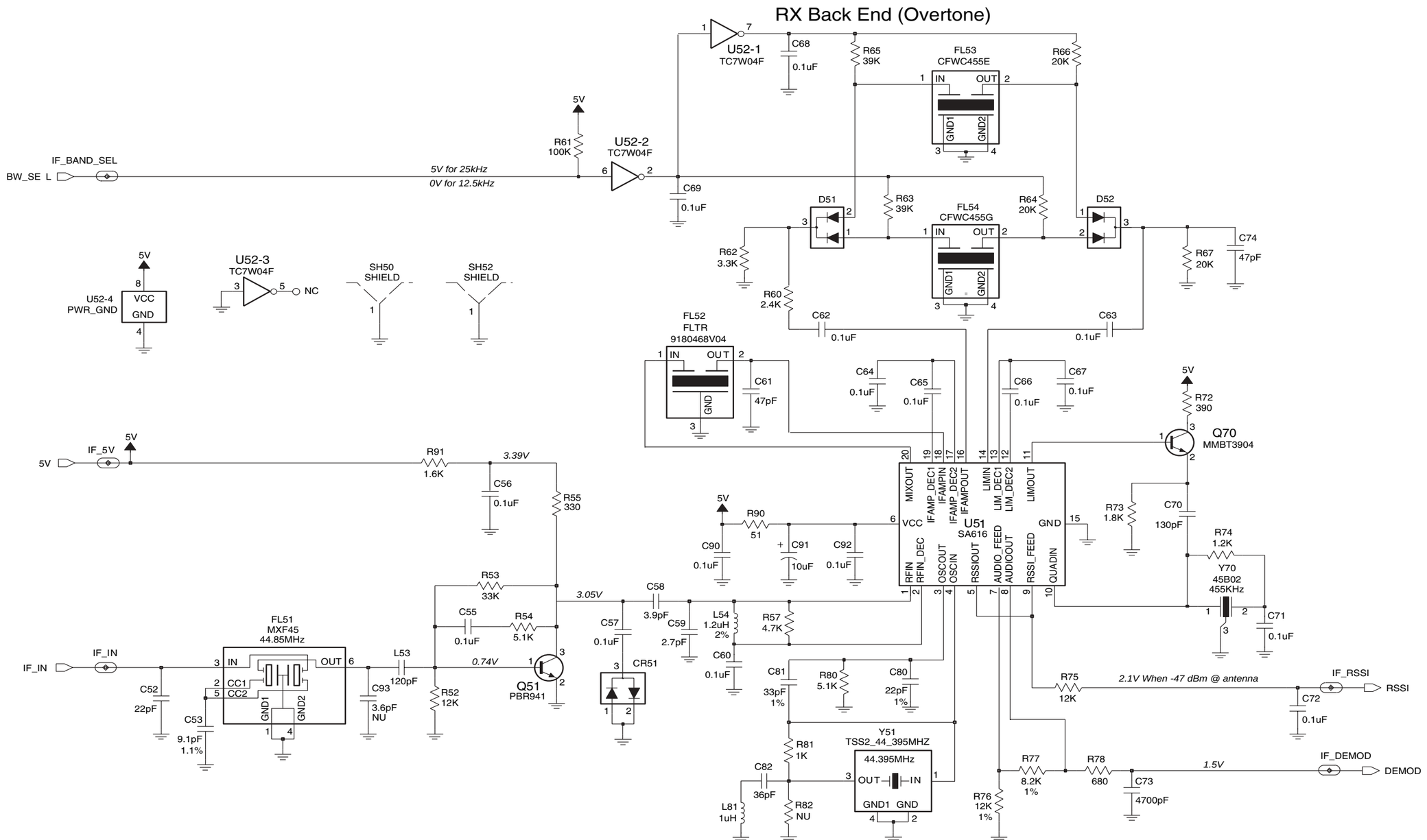
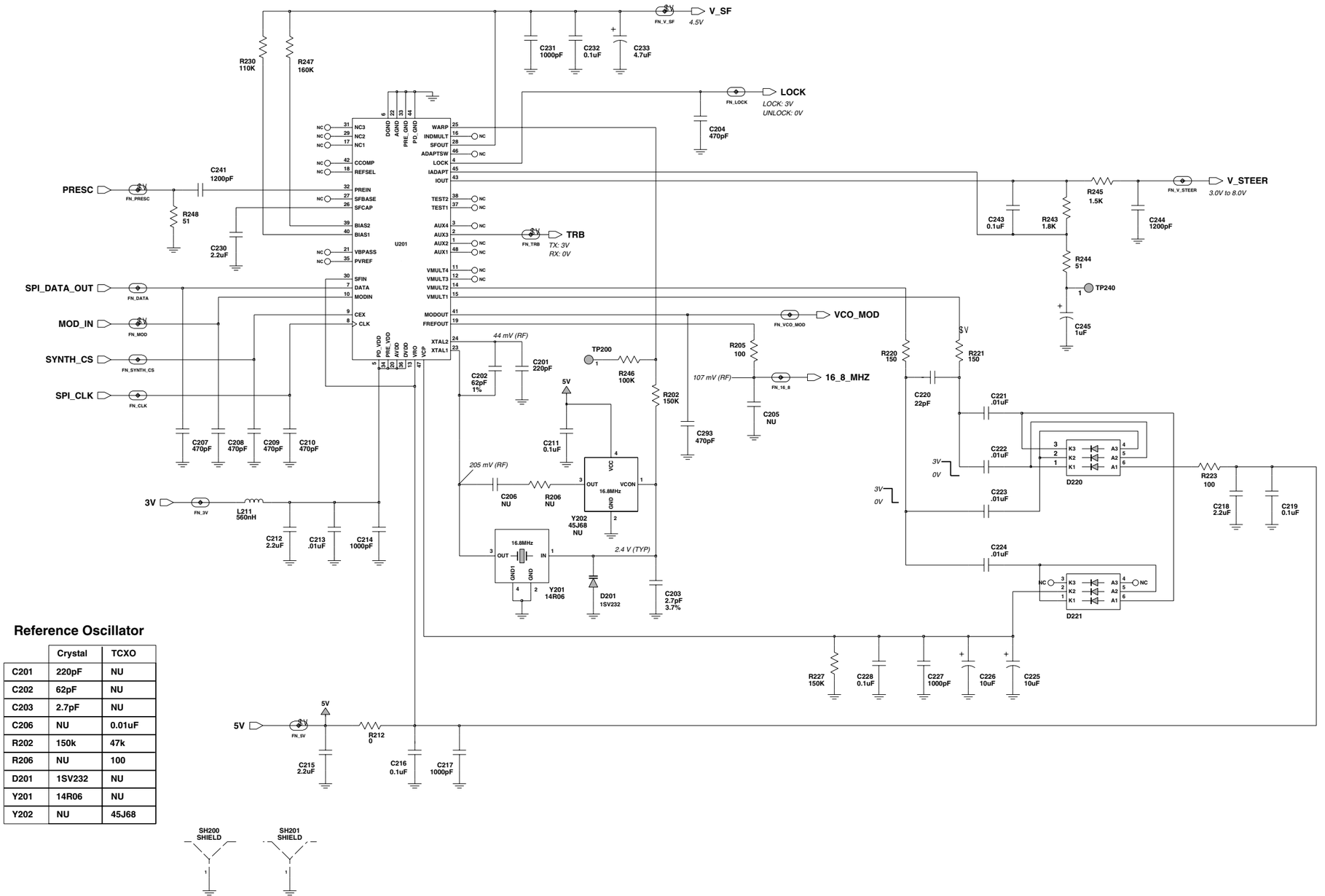


Figure 7-17. VHF (136-162 MHz) Receiver Back End Schematic Diagram (8486769Z04-C)



Reference Oscillator

	Crystal	TCXO
C201	220pF	NU
C202	62pF	NU
C203	2.7pF	NU
C206	NU	0.01uF
R202	150k	47k
R206	NU	100
D201	1SV232	NU
Y201	14R06	NU
Y202	NU	45J68

Figure 7-18. VHF (136-162 MHz) Synthesizer Schematic Diagram (8486769Z04-C)

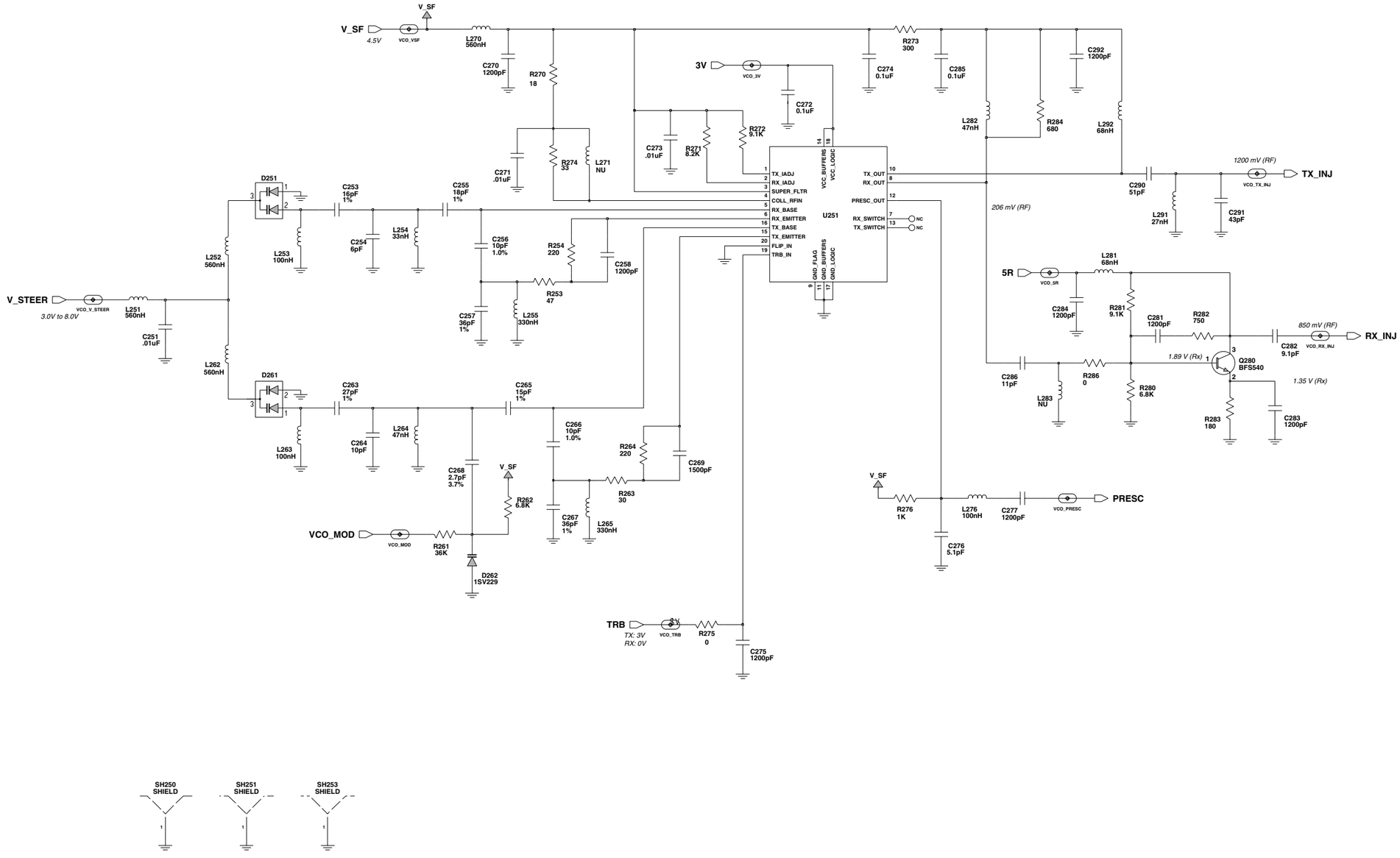


Figure 7-19. VHF (136-162 MHz) Voltage Controlled Oscillator Schematic Diagram (8486769Z04-C)

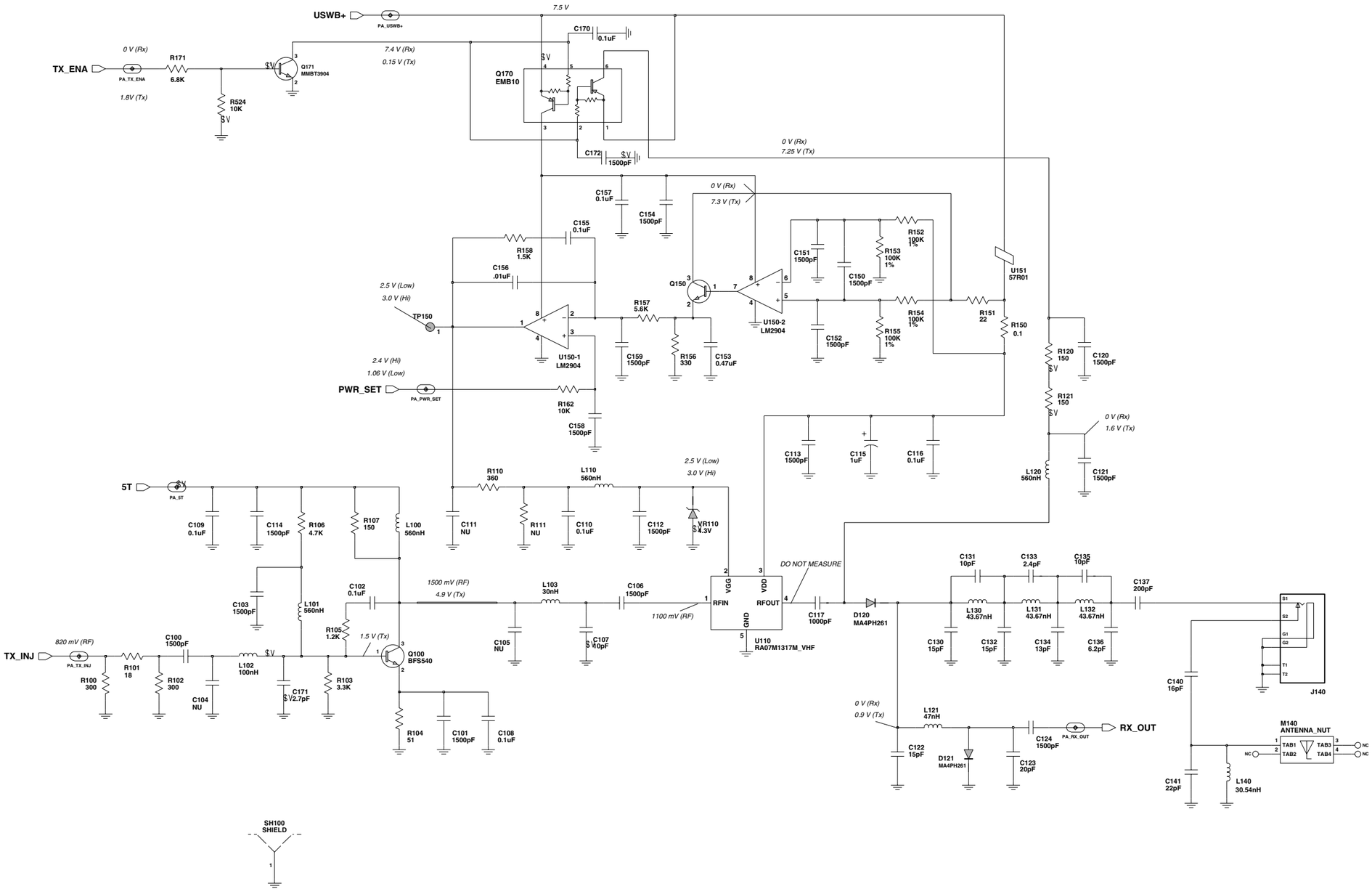


Figure 7-20. VHF (136-162 MHz) Transmitter and Power Control Schematic Diagram (8486769Z04-C)

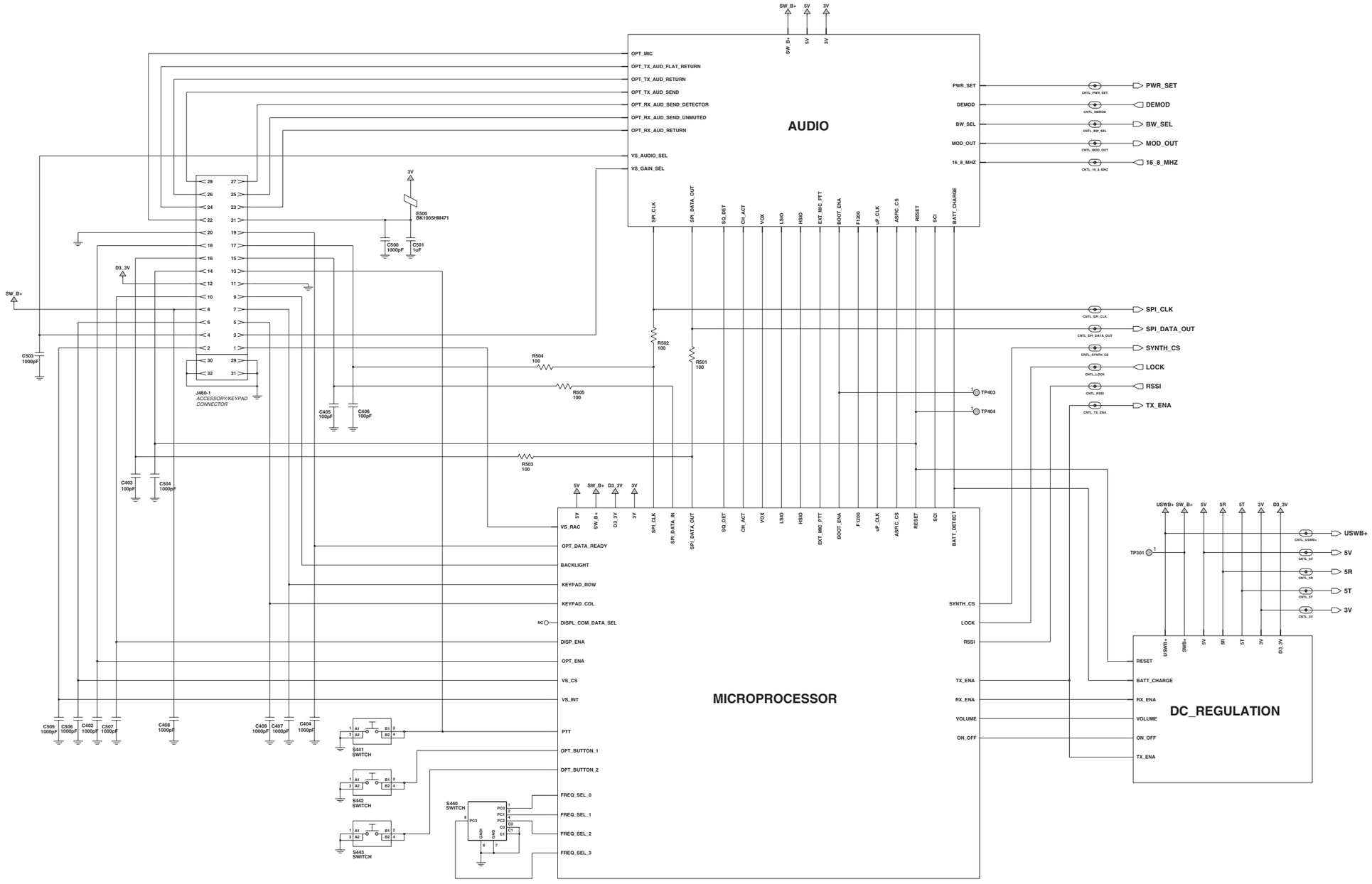


Figure 7-21. VHF (136-162 MHz) Controller Interconnect Schematic Diagram (8486769Z04-C)

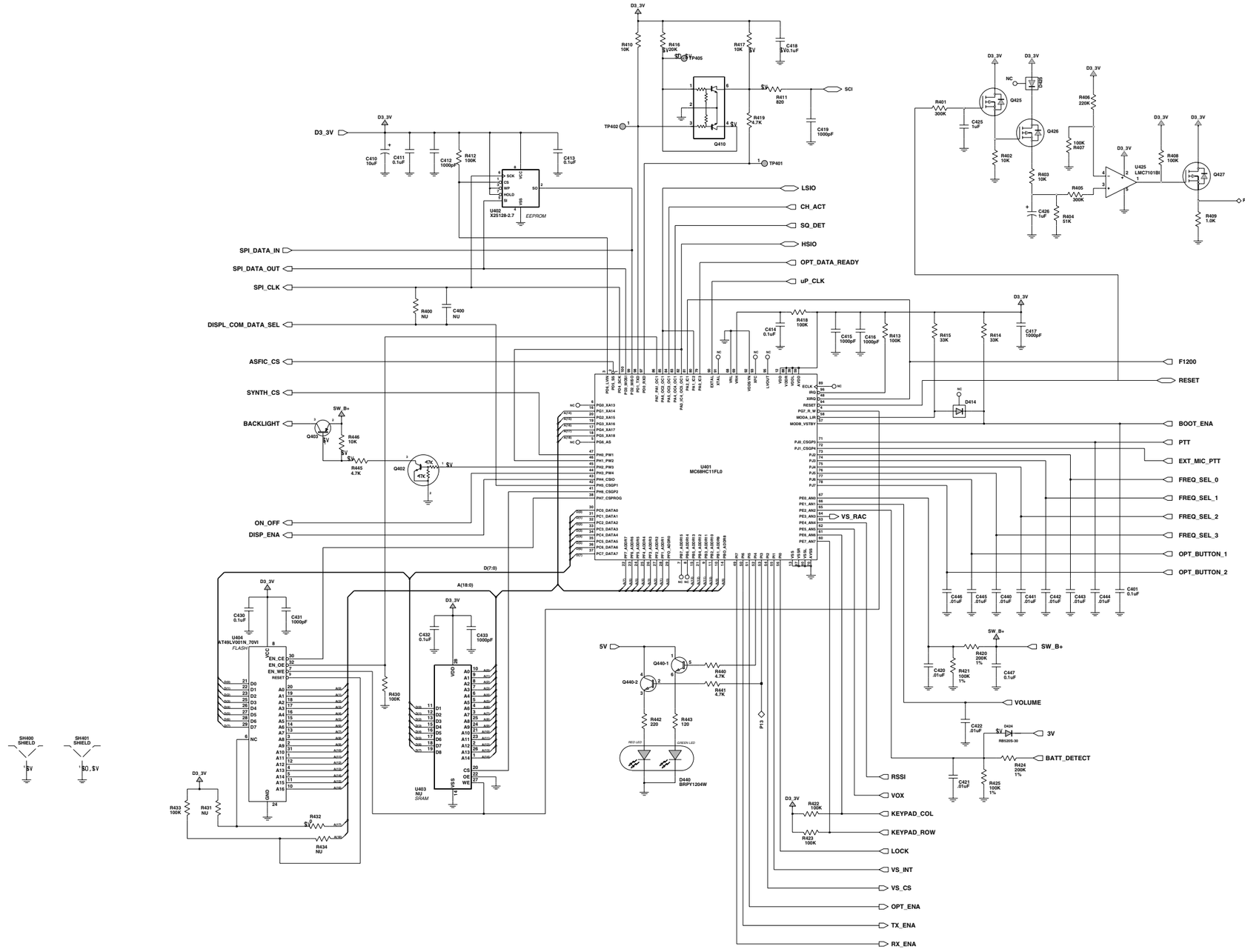
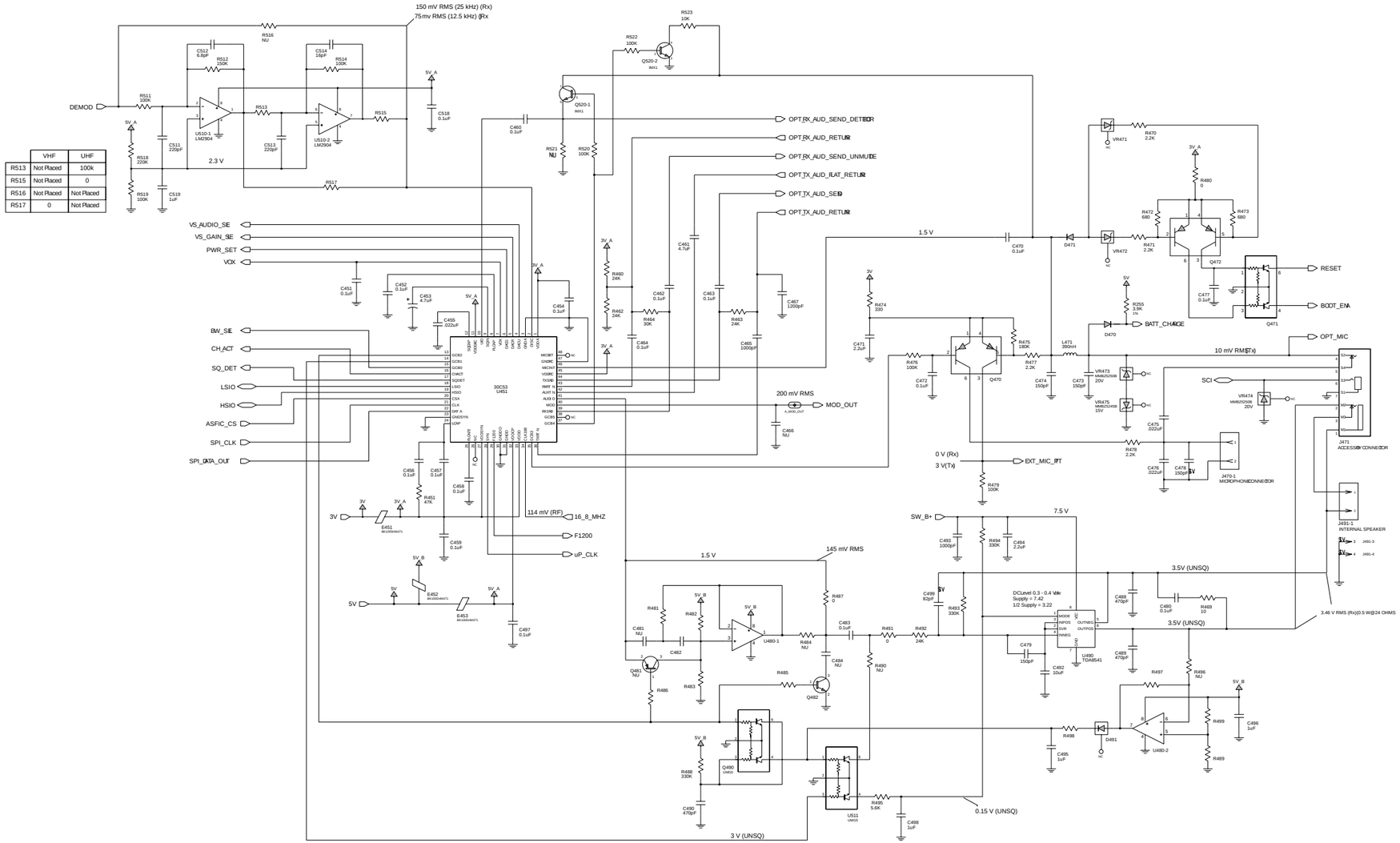


Figure 7-22. VHF (136-162 MHz) Microprocessor Circuitry Schematic Diagram (8486769Z04-C)



	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

Figure 7-23. VHF (136-162 MHz) Audio Circuitry Schematic Diagram (8486769Z04-C)

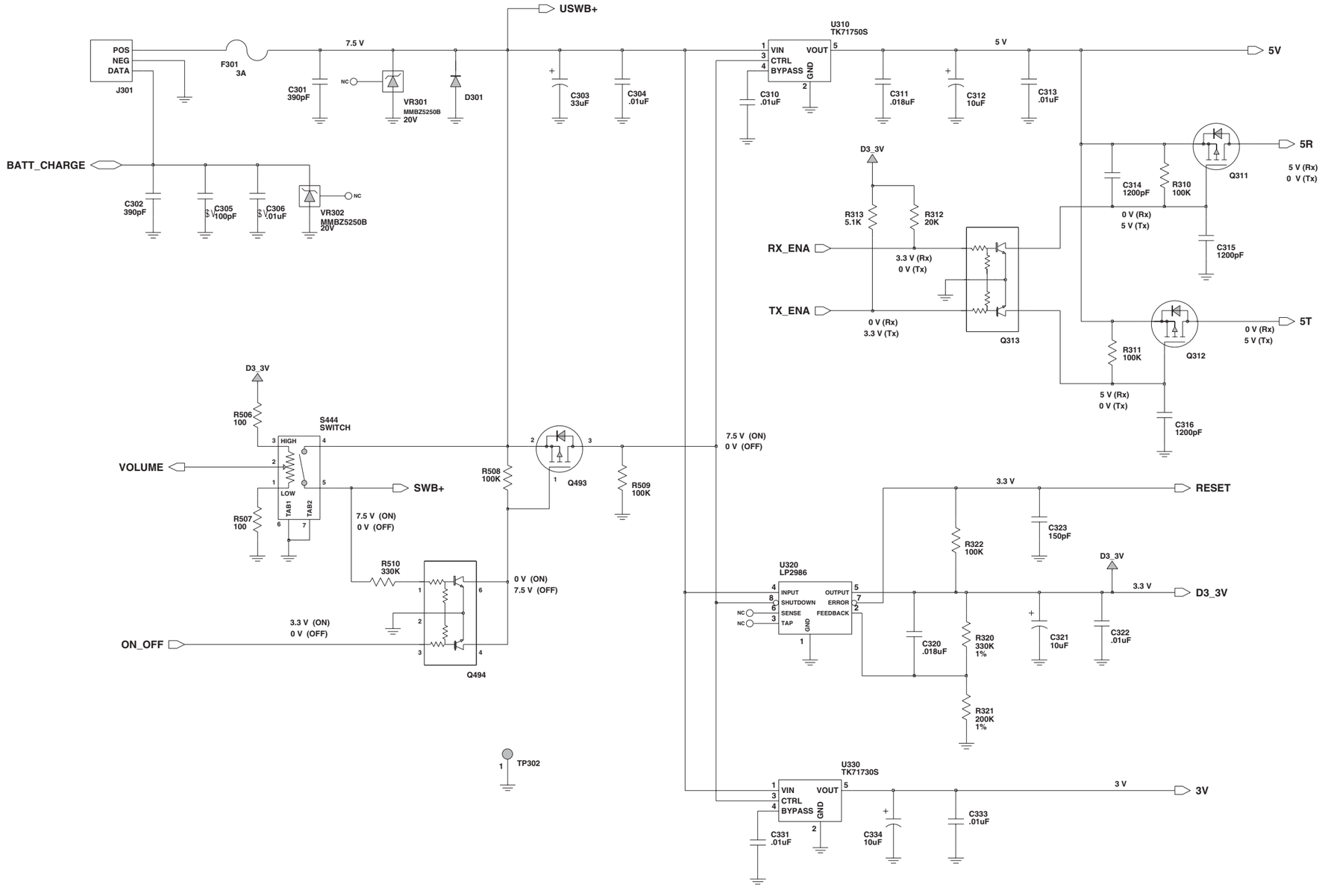


Figure 7-24. VHF (136-162 MHz) DC Regulation Schematic Diagram (8486769Z04-C)

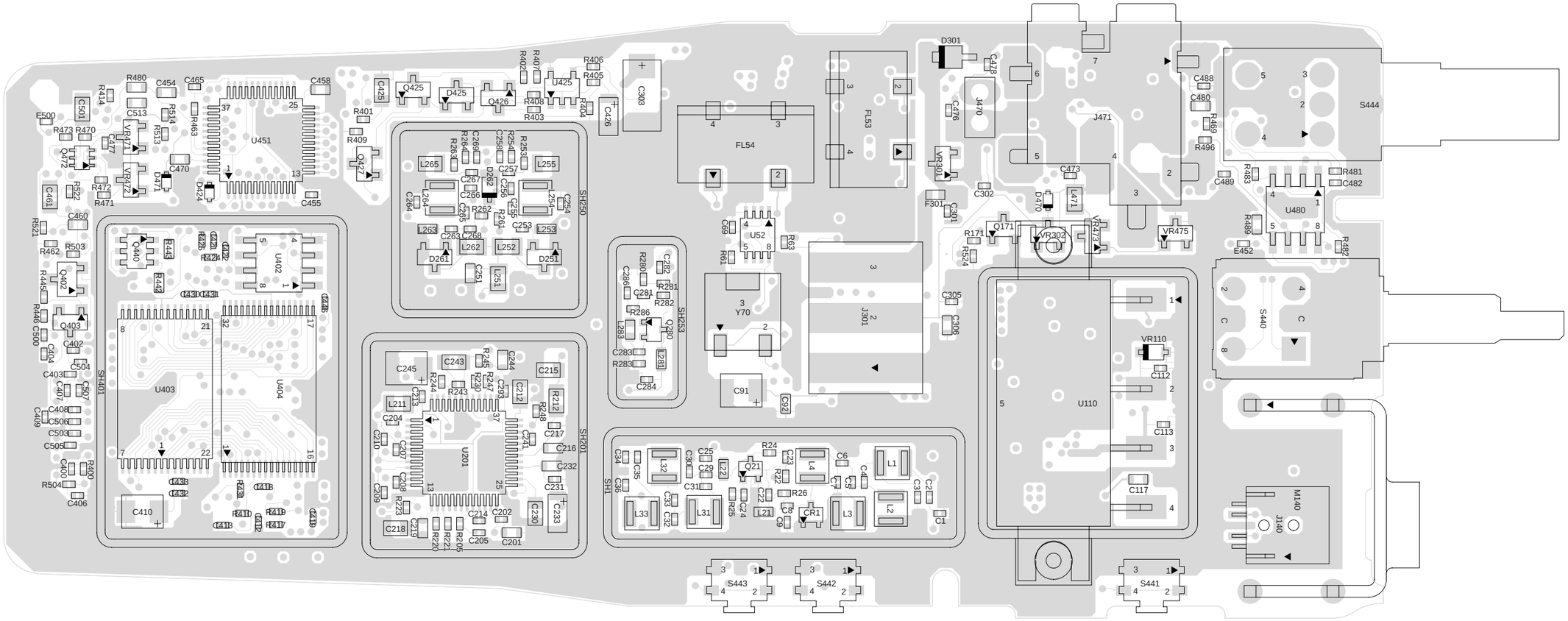
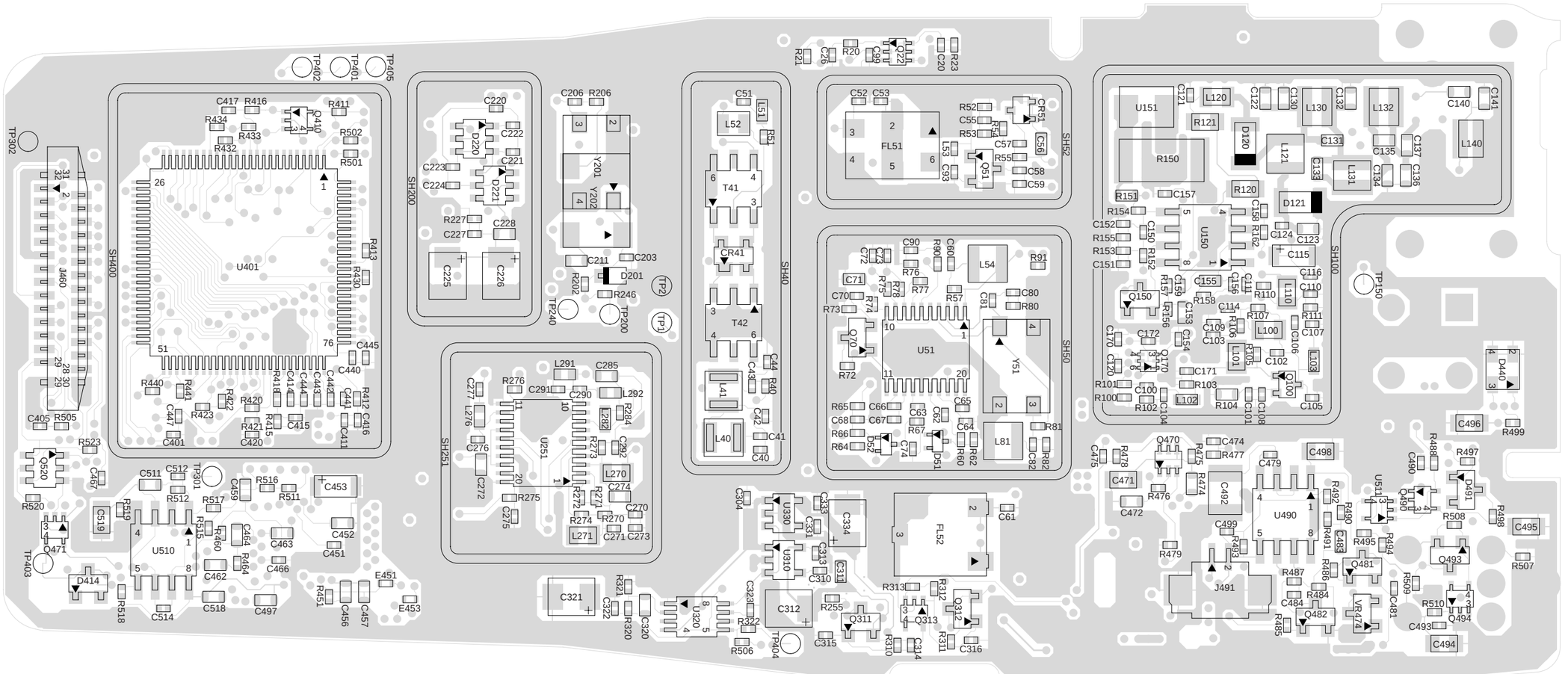


Figure 7-25. VHF (136-162 MHz) Board Component Side View (8486769Z04-C)



ZMY30001-O

Figure 7-26. VHF (136-162 MHz) Board Solder Side View (8486769Z04-C)

VHF (136-162 MHz) Radio Parts List (8486769Z04-C)

Circuit Ref	Motorola Part No.	Description
C1	2115153H43	CAP, 22pF
C2	2115153H48	CAP, 36pF
C3	2115153H49	CAP, 47pF
C4	2115153H39	CAP, 18pF
C5	2115153H15	CAP, 3.3
C6	2115153H41	CAP, 22pF
C7	2115153H45	CAP, 33pF
C8	2115153H44	CAP, 30pF
C9	Not_Placed	-
C20	2113945A09	CAP, 1000pF
C22	2113945A09	CAP, 1000pF
C23	2113945A09	CAP, 1000pF
C24	Not_Placed	-
C25	2113945A09	CAP, 1000pF
C26	2113945A09	CAP, 1000pF
C29	2115153H27	CAP, 10pF
C30	2115153H44	CAP, 30pF
C31	2115153H46	CAP, 36pF
C32	2115153H53	CAP, 68pF
C33	2115153H43	CAP, 27pF
C34	2115153H53	CAP, 68pF
C35	2115153H45	CAP, 33pF
C36	2115153H44	CAP, 30pF
C40	2115153H40	CAP, 20pF
C41	2115153H37	CAP, 15pF
C42	2115153H46	CAP, 36pF
C43	2115153H37	CAP, 15pF
C44	2115153H40	CAP, 20pF
C51	2113944A38	CAP, 82pF
C52	2115153H41	CAP, 22pF
C53	2115153H26	CAP, 9.1pF
C55	2113946K02	CAP, 100000pF
C56	2113945C31	CAP, 0.10uF
C57	2113946K02	CAP, 100000pF
C58	2113944A15	CAP, 25pF
C59	2113944A11	CAP, 2.7pF
C60	2113946K02	CAP, 100000pF
C61	2113944A36	CAP, 68pF
C62	2113946K02	CAP, 100000pF
C63	2113946K02	CAP, 100000pF
C64	2113946K02	CAP, 100000pF
C65	2113946K02	CAP, 100000pF
C66	2113946K02	CAP, 100000pF
C67	2113946K02	CAP, 100000pF
C68	2113946K02	CAP, 100000pF
C69	2113946K02	CAP, 100000pF
C70	2113944A87	CAP, 130pF
C71	2113945C31	CAP, 0.10uF
C72	2113946K02	CAP, 100000pF
C73	2113945A13	CAP, 4700pF
C74	2113944A33	CAP, 47pF
C80	2115153H41	CAP, 22pF
C81	2115153H45	CAP, 33pF
C82	2115153H46	CAP, 36pF
C90	2113946K02	CAP, 100000pF
C91	2313960D07	CAP, 10uF
C92	2113945C31	CAP, 0.10uF
C93	Not_Placed	-
C99	2113946K02	CAP, 100000pF
C100	2113945A10	CAP, 1500pF
C101	2113945A10	CAP, 1500pF
C102	2113946K02	CAP, 100000pF
C103	2113945A10	CAP, 1500pF
C104	Not_Placed	-
C105	Not_Placed	-
C106	2113945A10	CAP, 1500pF
C107	2113944A25	CAP, 10pF
C108	2113946K02	CAP, 100000pF
C109	2113946K02	CAP, 100000pF
C110	2113946K02	CAP, 100000pF
C111	Not_Placed	-
C112	2113945A10	CAP, 1500pF
C113	2113945A10	CAP, 1500pF
C114	2113945A10	CAP, 1500pF
C115	2313960B01	CAP, 1uF
C116	2113946K02	CAP, 100000pF
C117	2113945L25	CAP, 1000pF
C120	2113945A10	CAP, 1500pF
C121	2113945A10	CAP, 1500pF
C122	2113944C32	CAP, 15pF
C123	2113944C80	CAP, 20pF
C124	2113945A10	CAP, 1500pF
C130	2113944C32	CAP, 15pF
C131	2113944C30	CAP, 10pF
C132	2113944C32	CAP, 15pF
C133	2113944C15	CAP, 2.4pF
C134	2113944C78	CAP, 13pF
C135	2113944C30	CAP, 10pF
C136	2113944C72	CAP, 6.2pF
C137	2113944C89	CAP, 20pF0
C140	2113944C79	CAP, 16pF
C141	2113944C34	CAP, 22pF
C150	2113945A10	CAP, 1500pF
C151	2113945A10	CAP, 1500pF
C152	2113945A10	CAP, 1500pF
C153	2113946L04	CAP, 0.47uF
C154	2113945A10	CAP, 1500pF
C155	2113945C31	CAP, 0.10uF
C156	2113945B02	CAP, 10000pF
C157	2113946K02	CAP, 100000pF
C158	2113945A10	CAP, 1500pF
C159	2113945A10	CAP, 1500pF
C170	2113946K02	CAP, 100000pF
C171	2113944A11	CAP, 2.7pF
C172	2113945A10	CAP, 1500pF
C201	2113944C02	CAP, 220pF
C202	2115153H52	CAP, 68pF
C203	2115153H13	CAP, 2.7pF
C204	2113945A05	CAP, 470pF
C205	Not_Placed	-
C206	Not_Placed	-
C207	2113945A05	CAP, 470pF
C208	2113945A05	CAP, 470pF
C209	2113945A05	CAP, 470pF
C210	2113945A05	CAP, 470pF
C211	2113945C31	CAP, 0.10uF
C212	2113946N03	CAP, 2.2uF
C213	2113945B02	CAP, 10000pF
C214	2113945A09	CAP, 1000pF
C215	2113946N03	CAP, 2.2uF
C216	2113945C31	CAP, 0.10uF
C217	2113945A09	CAP, 1000pF
C218	2113946N03	CAP, 2.2uF
C219	2113945C31	CAP, 0.10uF
C220	2113944A29	CAP, 22pF
C221	2113945B02	CAP, 10000pF
C222	2113945B02	CAP, 10000pF
C223	2113945B02	CAP, 10000pF
C224	2113945B02	CAP, 10000pF
C225	2313960D07	CAP, 10uF
C226	2313960D07	CAP, 10uF
C227	2113945A09	CAP, 1000pF
C228	2113945C31	CAP, 0.10uF
C230	2113946N03	CAP, 2.2uF
C231	2113945A09	CAP, 1000pF
C232	2113945C31	CAP, 0.10uF
C233	2313960B30	CAP, 4.7pF
C241	2113945A60	CAP, 1200pF
C243	2113945G91	CAP, 100000pF
C244	2113945L27	CAP, 1200pF
C245	2313960C26	KEMET CAP
C251	2113945L49	CAP, 1000pF
C253	2115153H38	CAP, 16pF
C254	2115153H30	CAP, 6pF
C255	2115153H39	CAP, 18pF
C256	2115153H27	CAP, 10pF
C257	2115153H46	CAP, 36pF
C258	2113945A60	CAP, 1200pF
C263	2115153H43	CAP, 27pF
C264	2115153H27	CAP, 10pF
C265	2115153H37	CAP, 15pF
C266	2115153H27	CAP, 10pF
C267	2115153H46	CAP, 36pF
C268	2115153H13	CAP, 2.7pF
C269	2113945A10	CAP, 1500pF
C270	2113945A60	CAP, 1200pF
C271	2113945B02	CAP, 10000pF
C272	2113945C31	CAP, 0.10uF
C273	2113945B02	CAP, 10000pF
C274	2113945C31	CAP, 0.10uF
C275	2113945A60	CAP, 1200pF
C276	2113944A18	CAP, 5.1pF
C277	2113945A60	CAP, 1200pF
C281	2113945A60	CAP, 1200pF
C282	2113944A24	CAP, 9.1pF
C283	2113945A60	CAP, 1200pF
C284	2113945A60	CAP, 1200pF
C285	2113945C31	CAP, 0.10uF
C286	2113944A77	CAP, 11pF
C290	2113944A85	CAP, 51pF
C291	2115153H48	CAP, 43pF
C292	2113945A60	CAP, 1200pF
C293	2113945A05	CAP, 470pF
C301	2113945A04	CAP, 390pF
C302	2113945A04	CAP, 390pF
C303	2313960F04	CAP, 33uF
C304	2113945B02	CAP, 10000pF
C305	2113944A40	CAP, 100pF
C306	2113945L49	CAP, 1000pF
C310	2113945B02	CAP, 10000pF
C311	2113743E05	CAP, 0.18uF
C312	2313960D07	CAP, 10uF
C313	2113945B02	CAP, 10000pF
C314	2113945A60	CAP, 1200pF
C315	2113945A60	CAP, 1200pF
C316	2113945A60	CAP, 1200pF
C320	2113743E05	CAP, 0.18uF
C321	2313960D07	CAP, 10uF
C322	2113945B02	CAP, 10000pF
C323	2113944A42	CAP, 150pF
C331	2113945B02	CAP, 10000pF
C333	2113945B02	CAP, 10000pF
C334	2313960D07	CAP, 10uF
C400	Not_Placed	-
C401	2113946K02	CAP, 100000pF
C402	2113945A09	CAP, 1000pF
C403	2113944A40	CAP, 100pF
C404	2113945A09	CAP, 1000pF
C405	2113944A40	CAP, 100pF
C406	2113944A40	CAP, 100pF
C407	2113945A09	CAP, 1000pF
C408	2113945A09	CAP, 1000pF
C409	2113945A09	CAP, 1000pF

Circuit Ref	Motorola Part No.	Description
C410	2313960D07	CAP, 10uF
C411	2113946K02	CAP, 100000pF
C412	2113945A09	CAP, 1000pF
C413	2113946K02	CAP, 100000pF
C414	2113946K02	CAP, 100000pF
C415	2113945A09	CAP, 1000pF
C416	2113945A09	CAP, 1000pF
C417	2113945A09	CAP, 1000pF
C418	2113946K02	CAP, 100000pF
C419	2113945A09	CAP, 1000pF
C420	2113945B02	CAP, 10000pF
C421	2113945B02	CAP, 10000pF
C422	2113945B02	CAP, 10000pF
C425	2113946E02	CAP, 1uF
C426	2313960B01	CAP, 1uF
C430	2113946K02	CAP, 100000pF
C431	2113945A09	CAP, 1000pF
C432	2113946K02	CAP, 100000pF
C433	2113945A09	CAP, 1000pF
C440	2113945B02	CAP, 10000pF
C441	2113945B02	CAP, 10000pF
C442	2113945B02	CAP, 10000pF
C443	2113945B02	CAP, 10000pF
C444	2113945B02	CAP, 10000pF
C445	2113945B02	CAP, 10000pF
C446	2113945B02	CAP, 10000pF
C447	2113946K02	CAP, 100000pF
C451	2113946K02	CAP, 100000pF
C452	2113945C31	CAP, 0.10uF
C453	2313960B30	CAP, 4.7pF
C454	2113945C31	CAP, 0.10uF
C455	2113945B04	CAP, 22000pF
C456	2113945C31	CAP, 0.10uF
C457	2113945C31	CAP, 0.10uF
C458	2113945C31	CAP, 0.10uF
C459	2113945C31	CAP, 0.10uF
C460	2113945C31	CAP, 0.10uF
C461	2113946F03	CAP, 4.7uF
C462	2113945C31	CAP, 0.10uF
C463	2113945C31	CAP, 0.10uF
C464	2113945C31	CAP, 0.10uF
C465	2113945A09	CAP, 1000pF
C466	Not_Placed	-
C467	2113945A60	CAP, 1200pF
C470	2113945C31	CAP, 0.10uF
C471	2113946N03	CAP, 2.2uF
C472	2113945C31	CAP, 0.10uF
C473	2113944A42	CAP, 150pF
C474	2113944A42	CAP, 150pF
C475	2113945B04	CAP, 22000pF
C476	2113945B04	CAP, 22000pF
C477	2113946K02	CAP, 100000pF
C478	2113944A42	CAP, 150pF
C479	2113944A42	CAP, 150pF
C480	2113945C31	CAP, 0.10uF
C481	Not_Placed	-
C482	Not_Placed	-
C483	2113946C02	CAP, 0.22uF
C484	Not_Placed	-
C488	2113945A05	CAP, 470pF
C489	2113945A05	CAP, 470pF
C490	2113945A05	CAP, 470pF
C492	2113928J08	CAP, 10uF
C493	2113945A09	CAP, 1000pF
C494	2113946N03	CAP, 2.2uF
C495	2113946N02	CAP, 1uF
C496	2113946N02	CAP, 1uF
C497	2113945C31	CAP, 0.10uF
C498	2113946N02	CAP, 1uF
C499	2113944A32	CAP, 39pF
C500	2113945A09	CAP, 1000pF
C501	2113946N02	CAP, 1uF
C503	2113945A09	CAP, 1000pF
C504	2113945A09	CAP, 1000pF
C505	2113945A09	CAP, 1000pF
C506	2113945A09	CAP, 1000pF
C507	2113945A09	CAP, 1000pF
C511	2113944C02	CAP, 220pF
C512	2113944A21	CAP, 6.8pF
C513	2113944C02	CAP, 220pF
C514	2113944A79	CAP, 16pF
C518	2113945C31	CAP, 0.10uF
C519	2113946N02	CAP, 1uF
CR1	4813974A19	Diode Schottky
CR41	4815923H01	Diode Schottky
CR51	4813974A19	Diode Schottky
D51	4815047H01	Switching Diode
D52	4815047H01	Switching Diode
D120	4880973Z02	Pin Diode
D121	4880973Z02	Pin Diode
D201	4815072H01	Diode Varactor
D220	4815011H01	Diode Triple
D221	4815011H01	Diode Triple
D251	4813974A01	ISV 228
D261	4813974A01	ISV 228
D262	4885055Y01	Diode Varactor
D301	4815713H01	Diode Schottky
D414	4816064H01	RH29M19 LH
D424	4809924D29	Diode High Voltage
D425	4816064H01	RH29M19 LH
D440	4805729G49	Diode Red/Yel
D470	4809924D29	Diode High Voltage
D471	4809924D29	Diode High Voltage
D491	Not_Placed	-
E451	2480640Z01	Ferrite Bead
E452	2480640Z01	Ferrite Bead
E453	2480640Z01	Ferrite Bead
E500	2480640Z01	Ferrite Bead
F301	6515076H01	Fuse Chip SMT
FL51	9186801Z01	OSC,XTAL 44.85MHZ
FL52	9180468V04	4 Element FLTR
FL53	9180469V05	6 Element FLTR
FL54	9115811H01	6 Element FLTR
J140	0986428Z02	RF Jack
J301	0986565Z02	Battery CONN
J460	Not_Placed	-
J470	0985818A02	CONN 2 Pin
J471	0980683Z03	Audio Jack
J491	2815162H01	CONN_P
L1	2414015C09	INDCTR, 68nH
L2	2414015C09	INDCTR, 68nH
L3	2414015C09	INDCTR, 68nH
L4	2414015C09	INDCTR, 68nH
L21	Not_Placed	-
L22	2414017N24	INDCTR, 100nH
L31	2414015C09	INDCTR, 68nH
L32	2414015C09	INDCTR, 68nH
L33	2414015C09	INDCTR, 68nH
L40	2414015C09	INDCTR, 68nH
L41	2414015C09	INDCTR, 68nH
L51	2414017N26	INDCTR, 150nH
L52	2462587V43	INDCTR, 560nH
L53	2113944A41	CAP, 120 pF
L54	2414015A25	INDCTR, 1200nH
L81	2414015A19	INDCTR, 1000nH
L100	2414017K32	INDCTR, 560nH
L101	2414017K32	INDCTR, 560nH
L102	2415429H36	INDCTR, 100nH
L103	2415429H25	INDCTR, 30nH
L110	2414017K32	INDCTR, 560nH
L120	2414017K32	INDCTR, 560nH
L121	2415015H01	INDCTR, 47nH
L130	2479990N01	INDCTR, 43.67nH
L131	2479990N01	INDCTR, 43.67nH
L132	2479990N01	INDCTR, 43.67nH
L140	2479990M01	INDCTR, 30.54nH
L211	2414017K32	INDCTR, 560nH
L251	2414017K32	INDCTR, 560nH
L252	2414017K32	INDCTR, 560nH
L253	2415429H36	INDCTR, 100nH
L254	2414015C05	INDCTR, 33nH
L255	2414017K29	INDCTR, 330nH
L262	2414017K32	INDCTR, 560nH
L263	2415429H36	INDCTR, 100nH
L264	2414015C07	INDCTR, 47nH
L265	2414017K29	INDCTR, 330nH
L270	2414017K32	INDCTR, 560nH
L271	Not_Placed	-
L276	2414017N24	INDCTR, 100nH
L281	2414017N22	INDCTR, 68nH
L282	2414017N20	INDCTR, 47nH
L283	Not_Placed	-
L291	2414017N17	INDCTR, 27nH
L292	2414017N22	INDCTR, 68nH
L471	2414017K30	INDCTR, 390nH
M140	0286427Z01	Nut, Antenna
Q21	4815119H01	Transistor
Q22	4815267H01	Transistor
Q51	4815343H01	Transistor
Q70	4815056H01	Transistor
Q100	4815119H01	Transistor
Q150	4815056H01	Transistor
Q170	4809939C34	Transistor
Q171	4815056H01	Transistor
Q280	4815119H01	Transistor
Q311	4815069H02	TP010IT
Q312	4815069H02	TP010IT
Q313	4815066H01	Transistor
Q402	4813973A42	Transistor
Q403	4813973A13	XSTR PNP40V
Q410	4815066H01	Transistor
Q425	4815069H02	TP010IT
Q426	4815069H02	TP010IT
Q427	4815069H02	TP010IT
Q440	4815154H01	Transistor
Q470	4815267H01	Transistor
Q471	4815066H01	Transistor
Q472	4815267H01	Transistor
Q481	Not_Placed	-
Q482	Not_Placed	-
Q490	4815066H01	Transistor
Q493	4815069H02	TP010IT
Q494	4815066H01	Transistor
Q520	4815154H01	Transistor
R20	0613952Z52	RES, 6.8K
R21	0613952Q49	RES, 100
R22	0613952Q93	RES, 6800
R23	0613952Z58	RES, 22K
R24	0613952Q70	RES, 750
R25	0613952Q91	RES, 5600
R26	0613952R66	RES, 0
R40	0613952Q73	RES, 1000
R51	0613952Q42	RES, 51
R52	0613952R03	RES, 12K

Circuit Ref	Motorola Part No.	Description
R53	0613952R13	RES, 33K
R54	0613952Q90	RES, 5100
R55	0613952Q61	RES, 330
R57	0613952Q89	RES, 4700
R60	0613952Q82	RES, 2400
R61	0613952R25	RES, 100K
R62	0613952Q85	RES, 3300
R63	0613952R15	RES, 39K
R64	0613952R08	RES, 20K
R65	0613952R15	RES, 39K
R66	0613952R08	RES, 20K
R67	0613952R08	RES, 20K
R72	0613952Q63	RES, 390
R73	0613952Q79	RES, 1800
R74	0613952Q75	RES, 1200
R75	0613952R03	RES, 12K
R76	0613952Z55	RES, 12K
R77	0613952Z53	RES, 8.2K
R78	0613952Q69	RES, 680
R80	0613952Q90	RES, 5100
R81	0613952Q73	RES, 1000
R82	Not_Placed	-
R90	0613952Q42	RES, 51
R91	0613952Q78	RES, 1600
R100	0613952Q60	RES, 300
R101	0613952Q31	RES, 18
R102	0613952Q60	RES, 300
R103	0613952Q85	RES, 3300
R104	0613952H42	RES, 51
R105	0613952Q75	RES, 1200
R106	0613952Q89	RES, 4700
R107	0613952Q53	RES, 150
R110	0613952Q62	RES, 360
R111	0613952R01	RES, 10K
R120	0613958H53	RES, 150
R121	0613958H53	RES, 150
R150	0680539Z01	RES, 0.1
R151	0613952H33	RES, 22
R152	0613952P01	RES, 100K
R153	0613952P01	RES, 100K
R154	0613952P01	RES, 100K
R155	0613952P01	RES, 100K
R156	0613952Q61	RES, 330
R157	0613952Q91	RES, 5600
R158	0613952Q77	RES, 1500
R162	0613952R01	RES, 10K
R171	0613952Q93	RES, 6800
R202	0613952R29	RES, 150K
R205	0613952Q49	RES, 100
R206	Not_Placed	-
R212	0613958J74	RES, 0
R220	0613952Q53	RES, 150
R221	0613952Q53	RES, 150
R223	0613952Q49	RES, 100
R227	0613952R29	RES, 150K
R230	0613952R26	RES, 110K
R243	0613952Q79	RES, 1800
R244	0613952Q42	RES, 51
R245	0613952Q77	RES, 1500
R246	0613952R25	RES, 100K
R247	0613952R30	RES, 160K
R248	0613952Q42	RES, 51
R253	0613952Q41	RES, 47
R254	0613952Q57	RES, 220
R255	0613952Z46	RES, 3.9K
R261	0613952R14	RES, 36K
R262	0613952Q93	RES, 6800
R263	0613952Q36	RES, 30
R264	0613952Q57	RES, 220
R270	0613952Q31	RES, 18
R271	0613952Q95	RES, 8200
R272	0613952Q96	RES, 9100 2
R273	0613952Q60	RES, 300
R274	0613952Q37	RES, 33
R275	0613952R66	RES, 0
R276	0613952Q73	RES, 1000
R280	0613952Q93	RES, 6800
R281	0613952Q96	RES, 9100 2
R282	0613952Q70	RES, 750
R283	0613952Q55	RES, 180
R284	0613952Q69	RES, 680
R286	0613952R66	RES, 0
R310	0613952R25	RES, 100K
R311	0613952R25	RES, 100K
R312	0613952R08	RES, 20K
R313	0613952Q90	RES, 5100
R320	0613952Z80	RES, 330K
R321	0613952P30	RES, 200K
R322	0613952R25	RES, 100K
R400	Not_Placed	-
R401	0613952R36	RES, 300K
R402	0613952R01	RES, 10K
R403	0613952R01	RES, 10K
R404	0613952R18	RES, 51K
R405	0613952R36	RES, 300K
R406	0613952R33	RES, 220K
R407	0613952R25	RES, 100K
R408	0613952R25	RES, 100K
R409	0613952Q73	RES, 1000
R410	0613952R01	RES, 10K
R411	0613952Q71	RES, 820
R412	0613952R25	RES, 100K
R413	0613952R25	RES, 100K
R414	0613952R13	RES, 33K
R415	0613952R13	RES, 33K
R416	0613952R08	RES, 20K
R417	0613952R01	RES, 10K
R418	0613952R25	RES, 100K
R419	0613952Q89	RES, 4700
R420	0613952P30	RES, 200K
R421	0613952P01	RES, 100K
R422	0613952R25	RES, 100K
R423	0613952R25	RES, 100K
R424	0613952P30	RES, 200K
R425	0613952P01	RES, 100K
R430	0613952R25	RES, 100K
R431	Not_Placed	-
R432	0613952R66	RES, 0
R433	0613952R25	RES, 100K
R434	Not_Placed	-
R440	0613952Q89	RES, 4700
R441	0613952Q89	RES, 4700
R442	0613952H57	RES, 220
R443	0613952H51	CHIP RES 120
R445	0613952Q89	RES, 4700
R446	0613952R01	RES, 10K
R451	0613952R17	RES, 47K
R460	0613952R10	RES, 24K
R462	0613952R10	RES, 24K
R463	0613952R10	RES, 24K
R464	0613952R12	RES, 30K
R469	0613952Q25	RES, 10
R470	0613952Q81	RES, 2200
R471	0613952Q81	RES, 2200
R472	0613952Q69	RES, 680
R473	0613952Q69	RES, 680
R474	0613952H61	RES, 330
R475	0613952R31	RES, 180K
R476	0613952R25	RES, 100K
R477	0613952Q81	RES, 2200
R478	0613952Q81	RES, 2200
R479	0613952R25	RES, 100K
R480	0613952G67	RES, 0
R481	Not_Placed	-
R482	Not_Placed	-
R483	Not_Placed	-
R484	Not_Placed	-
R485	Not_Placed	-
R486	Not_Placed	-
R487	0613952R66	RES, 0
R488	0613952R37	RES, 330K
R489	Not_Placed	-
R490	Not_Placed	-
R491	0613952R66	RES, 0
R492	0613952R10	RES, 24K
R493	0613952R37	RES, 330K
R494	0613952Z80	RES, 330K
R495	0613952Q91	RES, 5600
R496	Not_Placed	-
R497	Not_Placed	-
R498	Not_Placed	-
R499	Not_Placed	-
R501	0613952Q49	RES, 100
R502	0613952Q49	RES, 100
R503	0613952Q49	RES, 100
R504	0613952Q49	RES, 100
R505	0613952Q49	RES, 100
R506	0613952Q49	RES, 100
R507	0613952Q49	RES, 100
R508	0613952R25	RES, 100K
R509	0613952R25	RES, 100K
R510	0613952R37	RES, 330K
R511	0613952R25	RES, 100K
R512	0613952R29	RES, 150K
R513	Not_Placed	-
R514	0613952R25	RES, 100K
R515	Not_Placed	-
R516	Not_Placed	-
R517	0613952R66	RES, 0
R518	0613952R33	RES, 220K
R519	0613952R25	RES, 100K
R520	0613952R25	RES, 100K
R521	Not_Placed	-
R522	0613952R25	RES, 100K
R523	0613952R01	RES, 10K
R524	0613952R01	RES, 10K
S440	4080710Z24	Switch
	4080710Z26	Switch
S441	4070354A01	Switch
S442	4070354A01	Switch
S443	4070354A01	Switch
S444	1880619Z04	Potentiometer
SH1	2686421Z02	Shield
SH40	2686419Z02	Shield
SH50	2686423Z02	Shield
SH52	2686424Z02	Shield
SH100	2686418Z02	Shield
SH200	2686424Z02	Shield
SH201	2686423Z02	Shield
SH250	2686425Z02	Shield
SH251	2686425Z02	Shield
SH253	2686422Z02	Shield
SH400	2686420Z03	Shield
SH401	2686420Z03	Shield

Circuit Ref	Motorola Part No.	Description
T41	2515121H01	Balun Transformer
T42	2515121H01	Balun Transformer
U51	5115281H01	SA616
U52	5115070H01	TC7W04FU
U110	0178034A01	PA Module
U150	5114005A01	LM2904DR
U151	2415954H01	INDCTR Bead
U201	5185177Y01	AT25016
U251	5105750U56	VCO Buffer IC
U310	5115746H01	Voltage Regulator
U320	5115679H01	Voltage Regulator
U330	5115745H01	Voltage Regulator
U401	5185143E03	68HC11FLO
U402	5115033H01	EEPROM IC
U403	Not_Placed	-
U404	5115032H01	Flash 128K
U425	5115697H01	OP AMP
U451	5115062H01	IC ASFIC_CMP_R1
U480	Not_Placed	-
U490	9115811H03	Audio Amplifier
U510	5114005A01	LM2904DR
U511	4815066H01	Transistor
VR110	4813977A59	Diode Zener
VR301	4813977M29	Diode 20V
VR302	4813977M29	Diode 20V
VR471	4813977M14	Diode 6.8V
VR472	4813977M05	Diode 3.3V
VR473	4813977M29	Diode 20V
VR474	4813977M29	Diode 20V
VR475	4813977M24	Diode Zener
Y51	4802245J84	XTAL 44.395MHz
Y70	9186145B02	CDBCA455CX36-TC
Y201	4880114R06	Crystal 16.8MHZ
Y202	Not_Placed	-

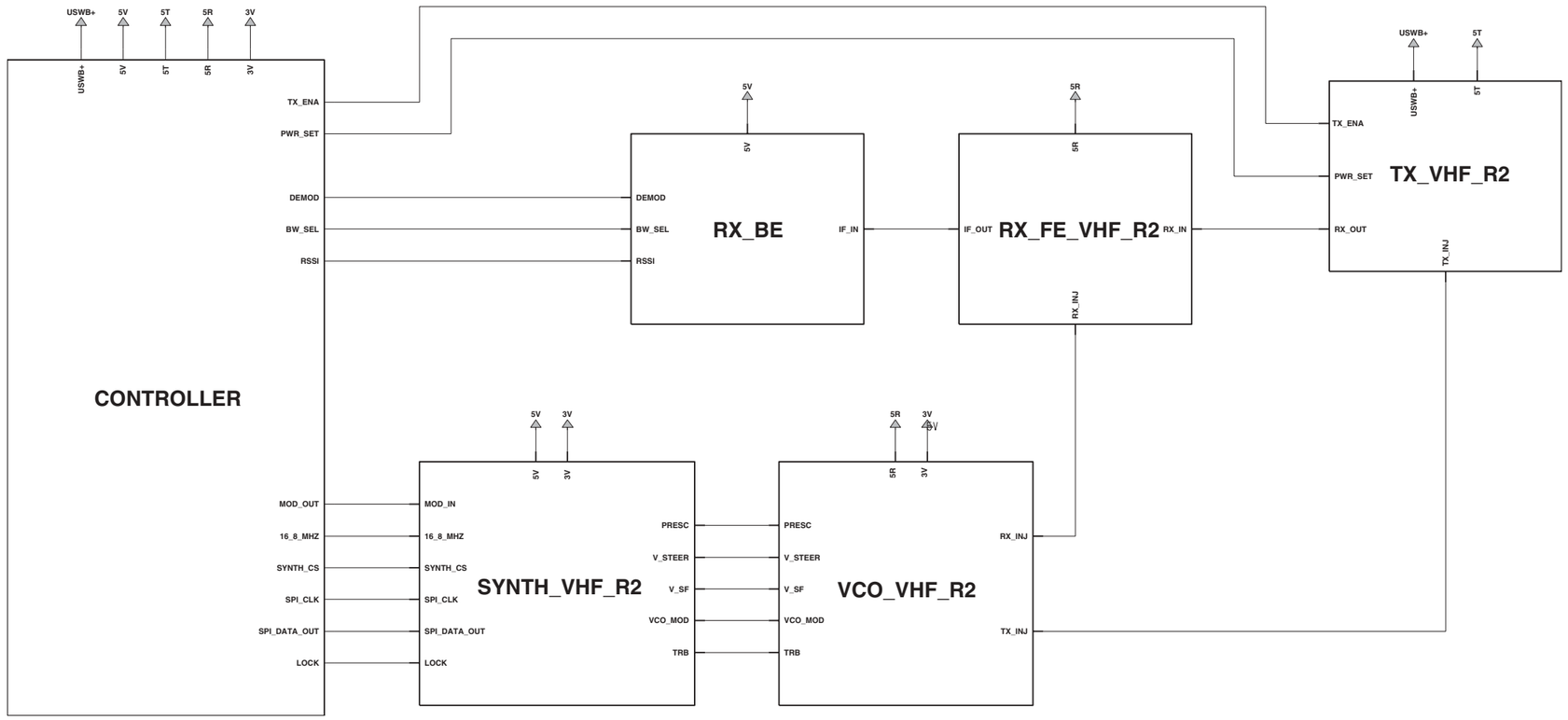


Figure 7-27. VHF (146-174 MHz) Radio Circuit Block Interconnect Diagram (8486342Z09-A)

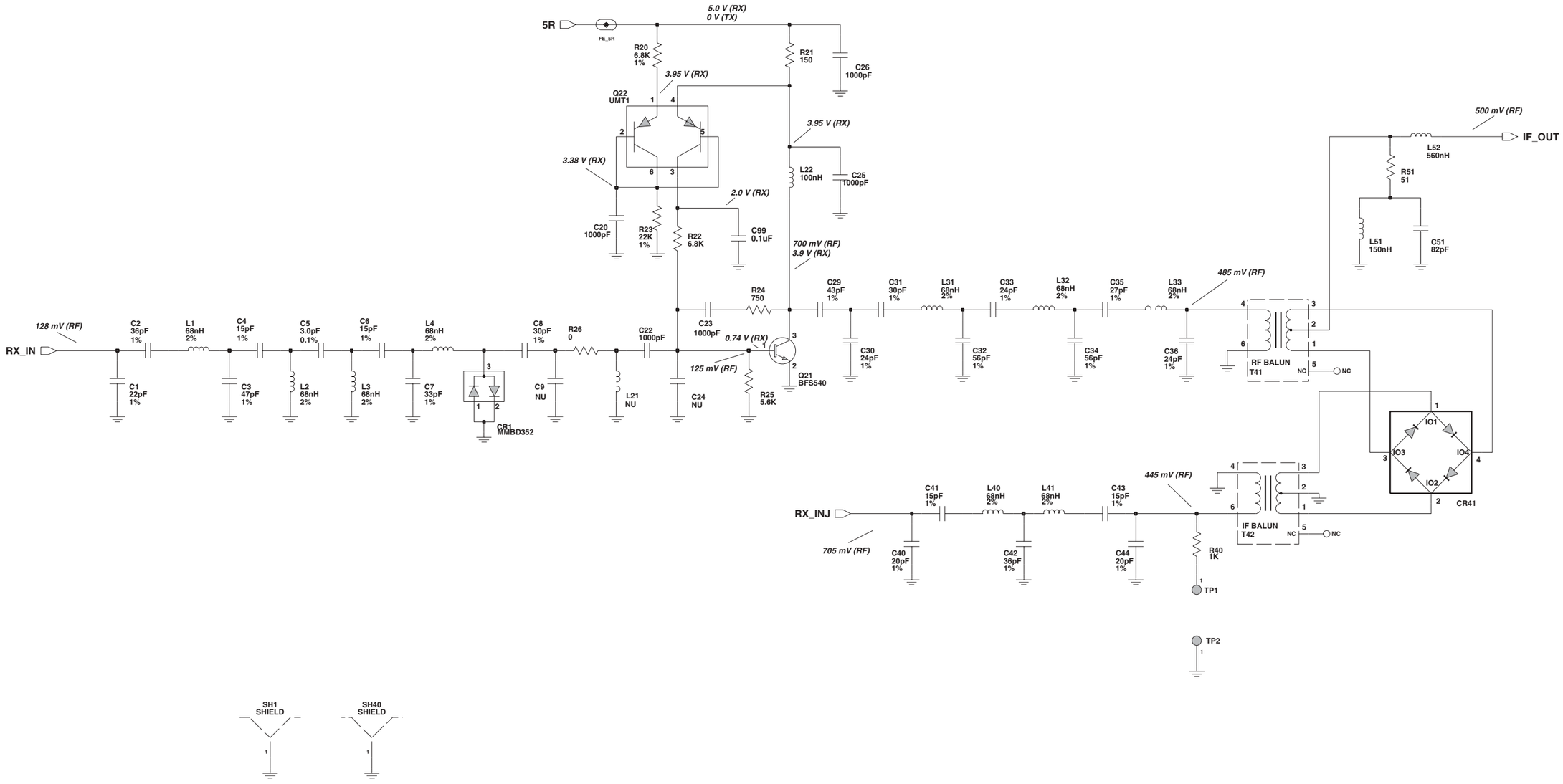


Figure 7-28. VHF (146-174 MHz) Receiver Front End Schematic Diagram (8486342Z09-A)

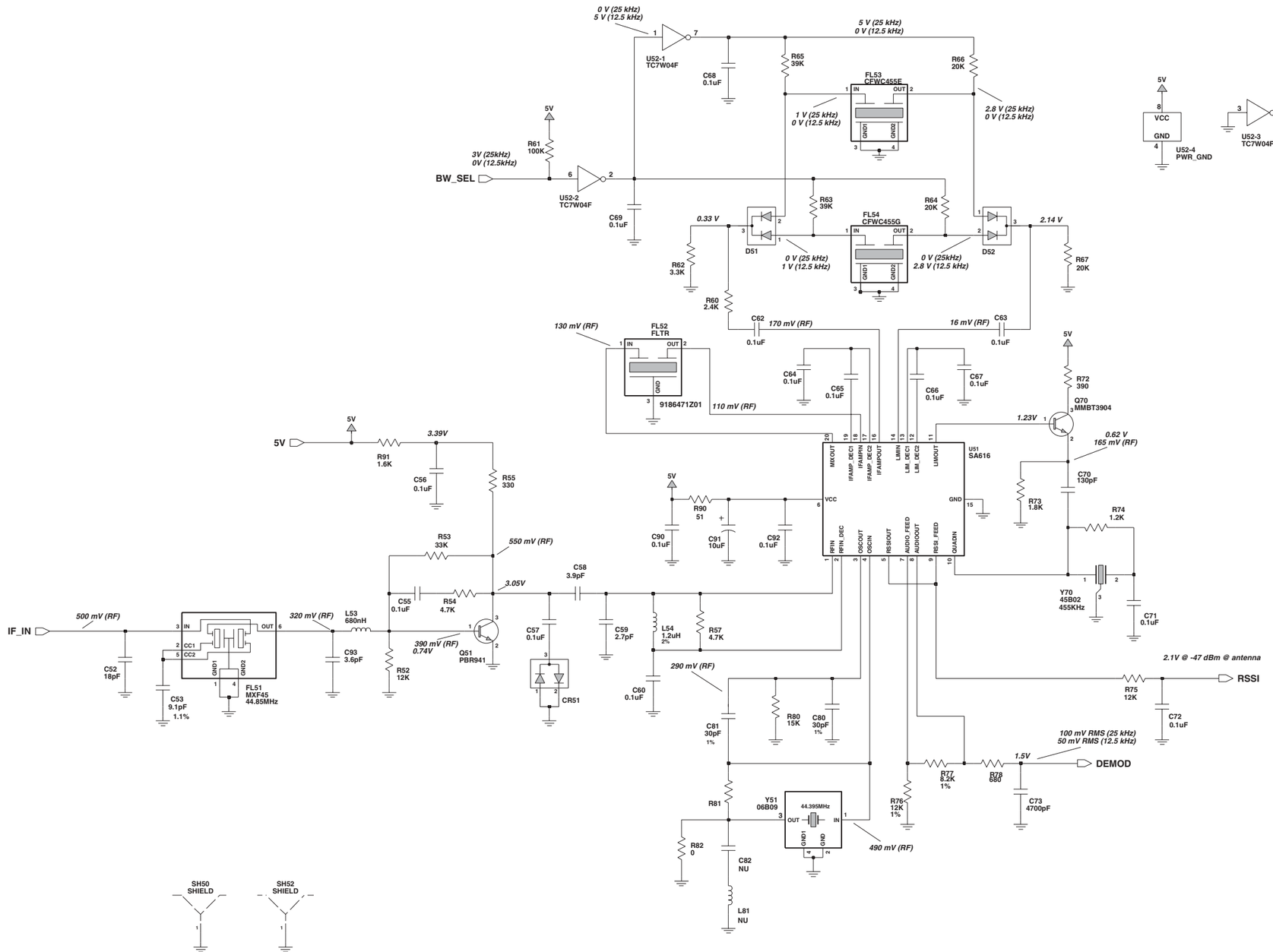


Figure 7-29. VHF (146-174 MHz) Receiver Back End Schematic Diagram (8486342Z09-A)

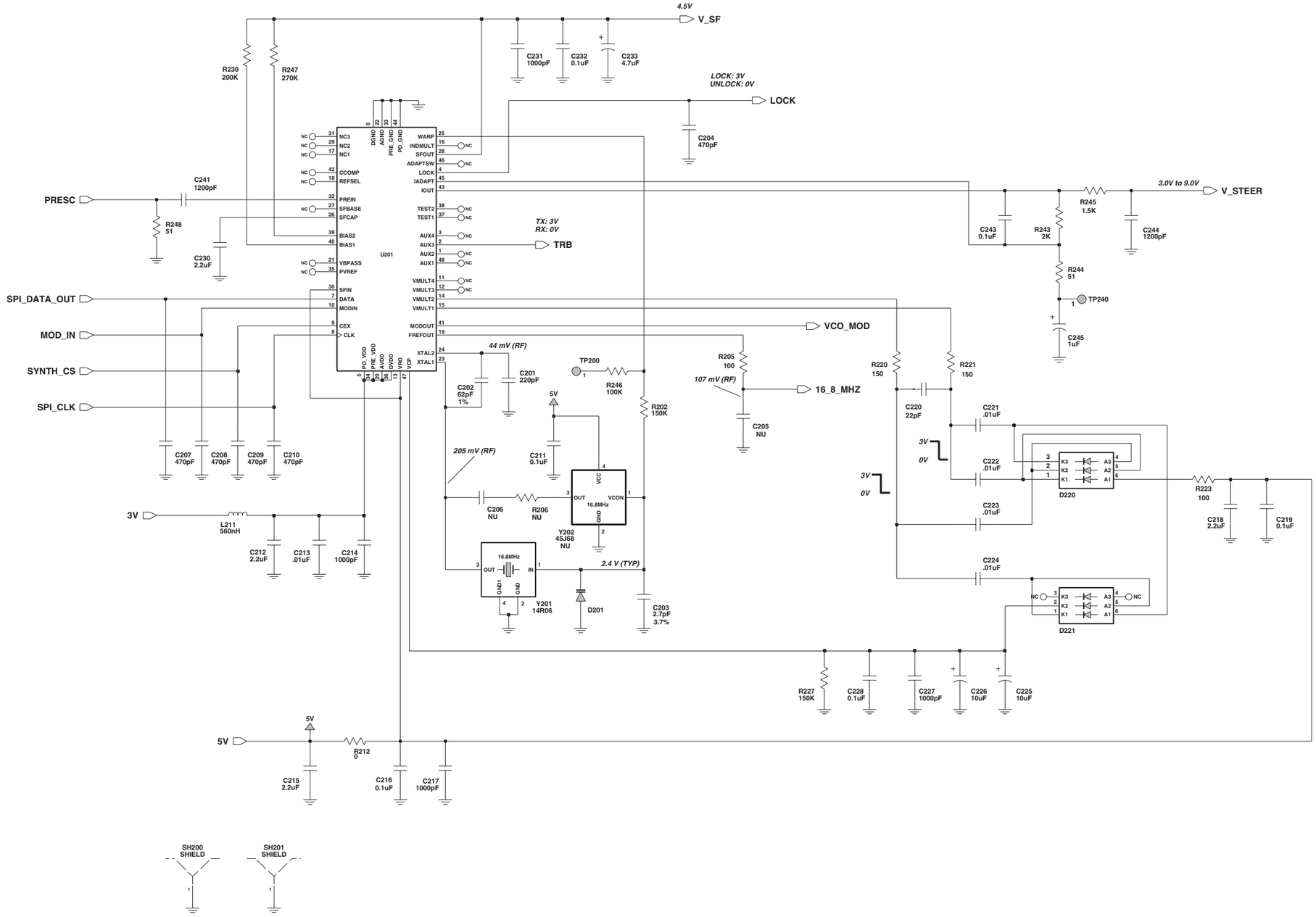


Figure 7-30. VHF (146-174 MHz) Synthesizer Schematic Diagram (8486342Z09-A)

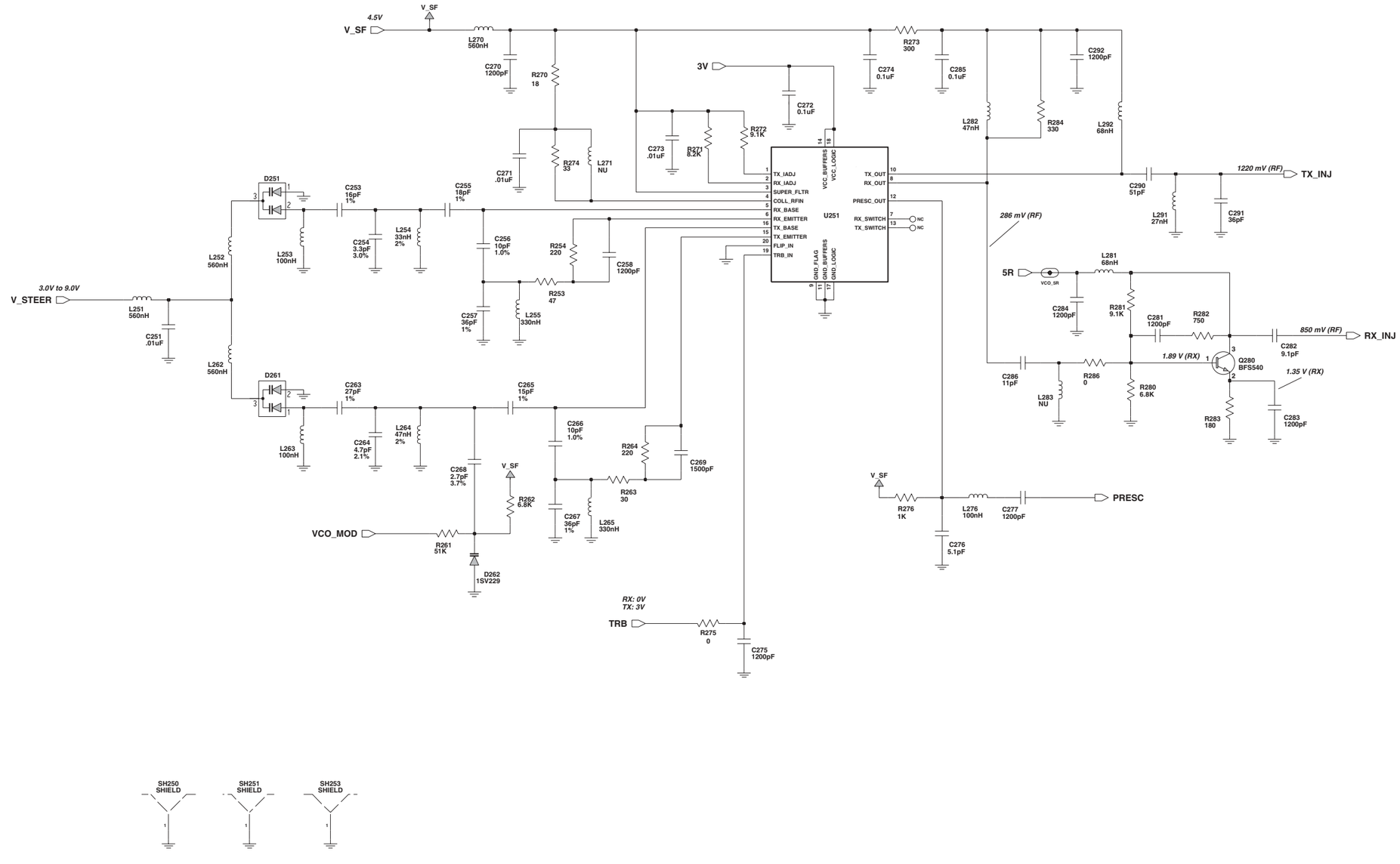


Figure 7-31. VHF (146-174 MHz) Voltage Controlled Oscillator Schematic Diagram (8486342Z09-A)

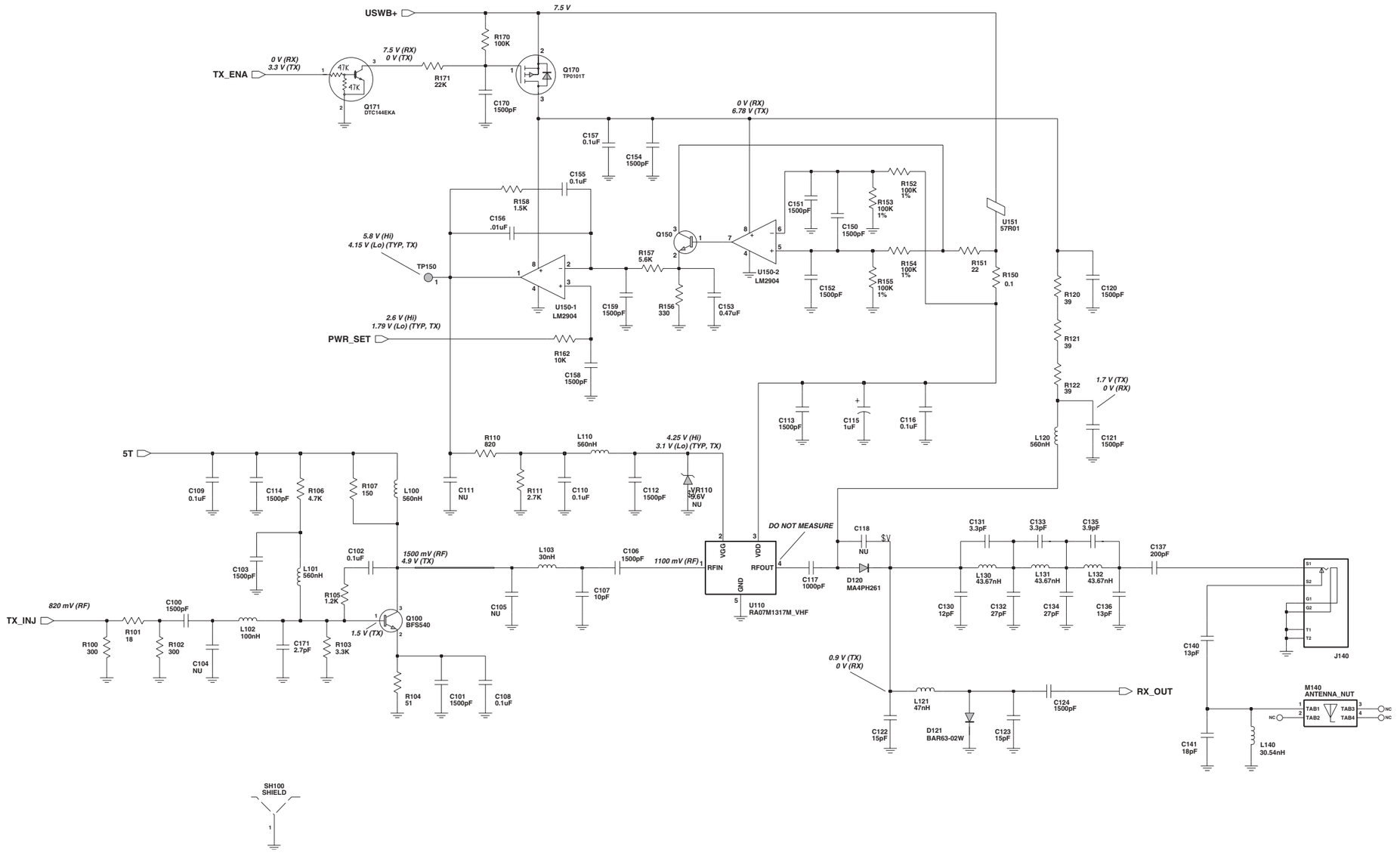


Figure 7-32. VHF (146-174 MHz) Transmitter and Power Control Schematic Diagram (8486342Z09-A)

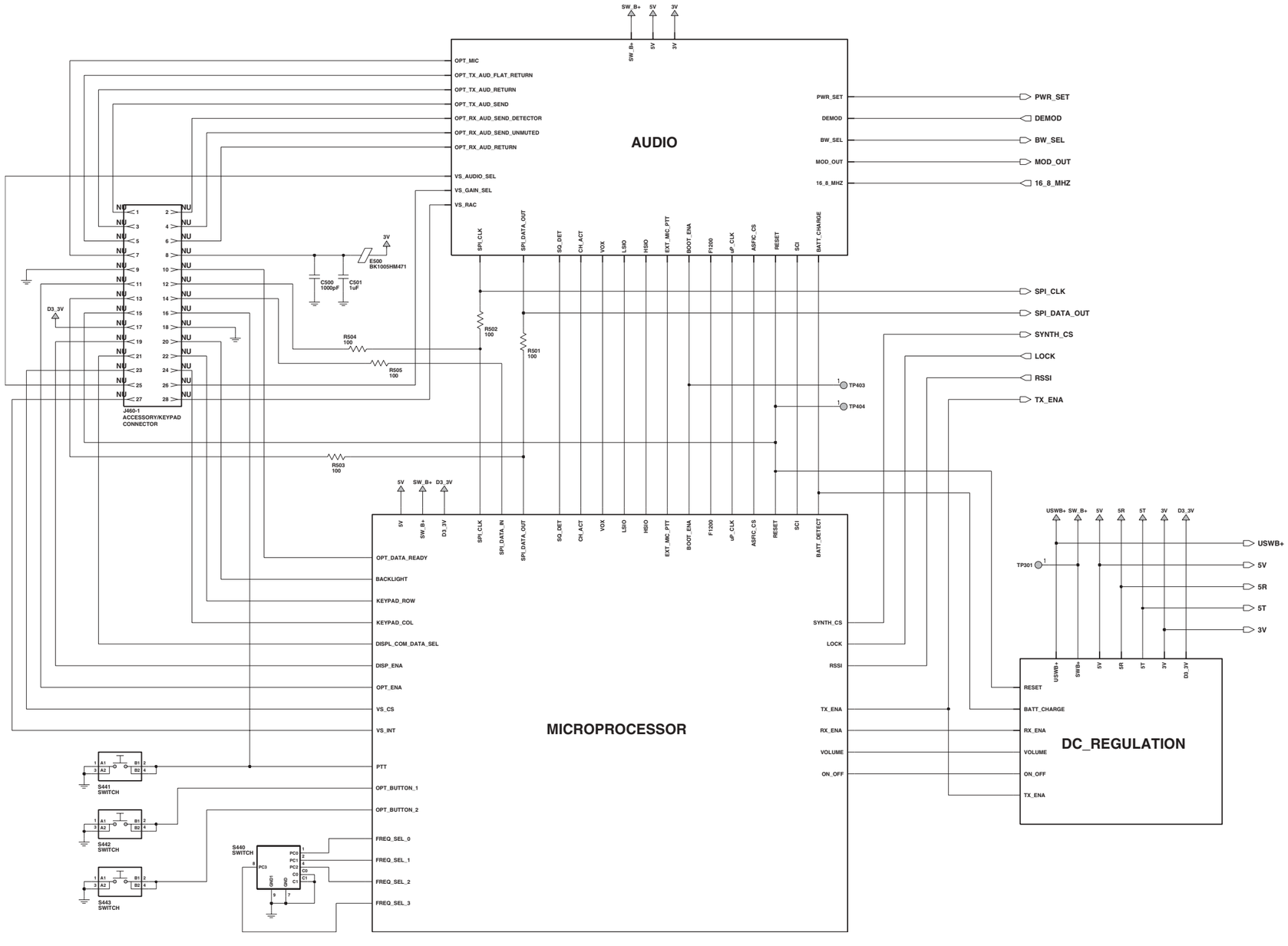


Figure 7-33. VHF (146-174 MHz) Controller Interconnect Schematic Diagram (8486342Z09-A)

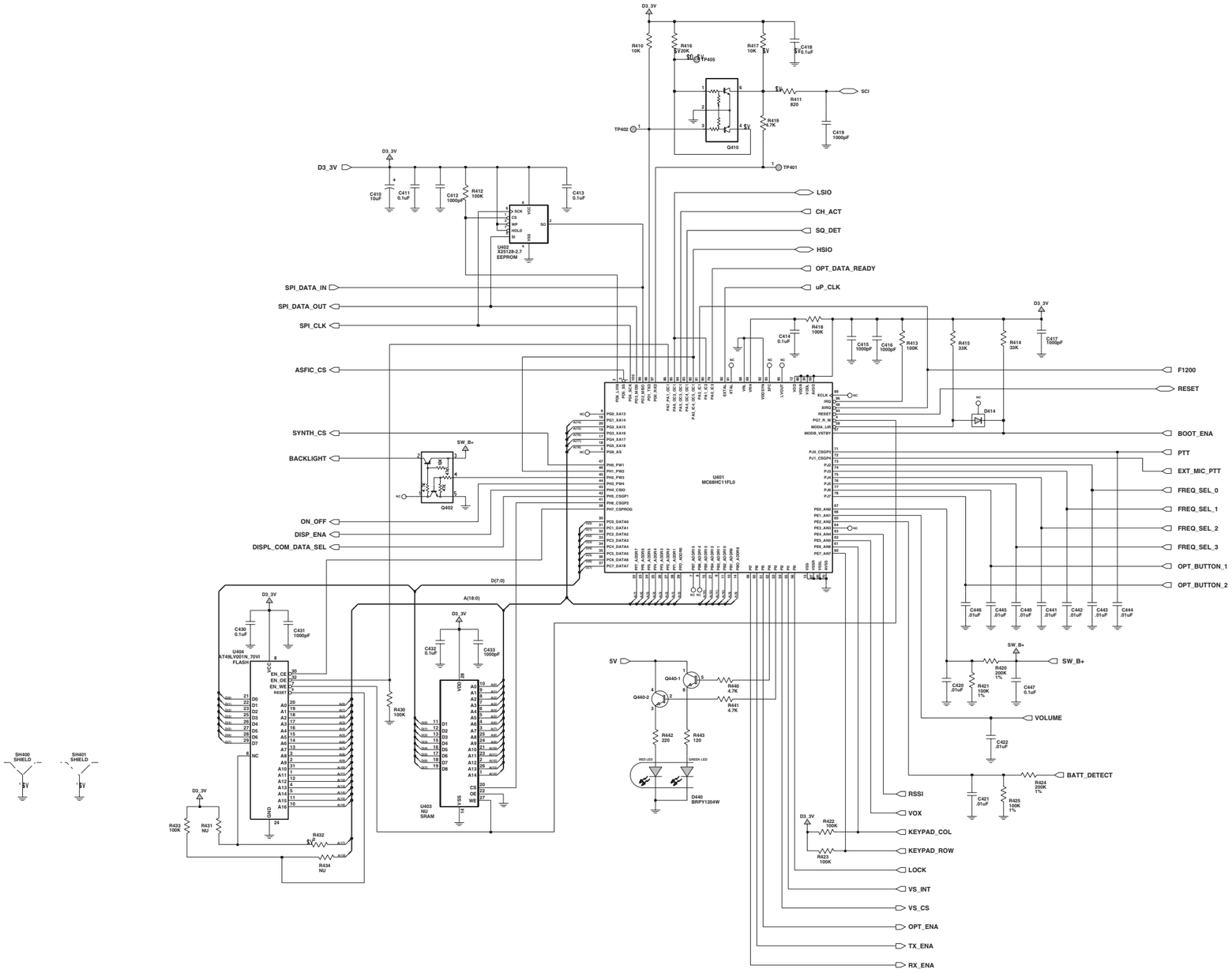


Figure 7-34. VHF (146-174 MHz) Microprocessor Circuitry Schematic Diagram (8486342Z09-A)

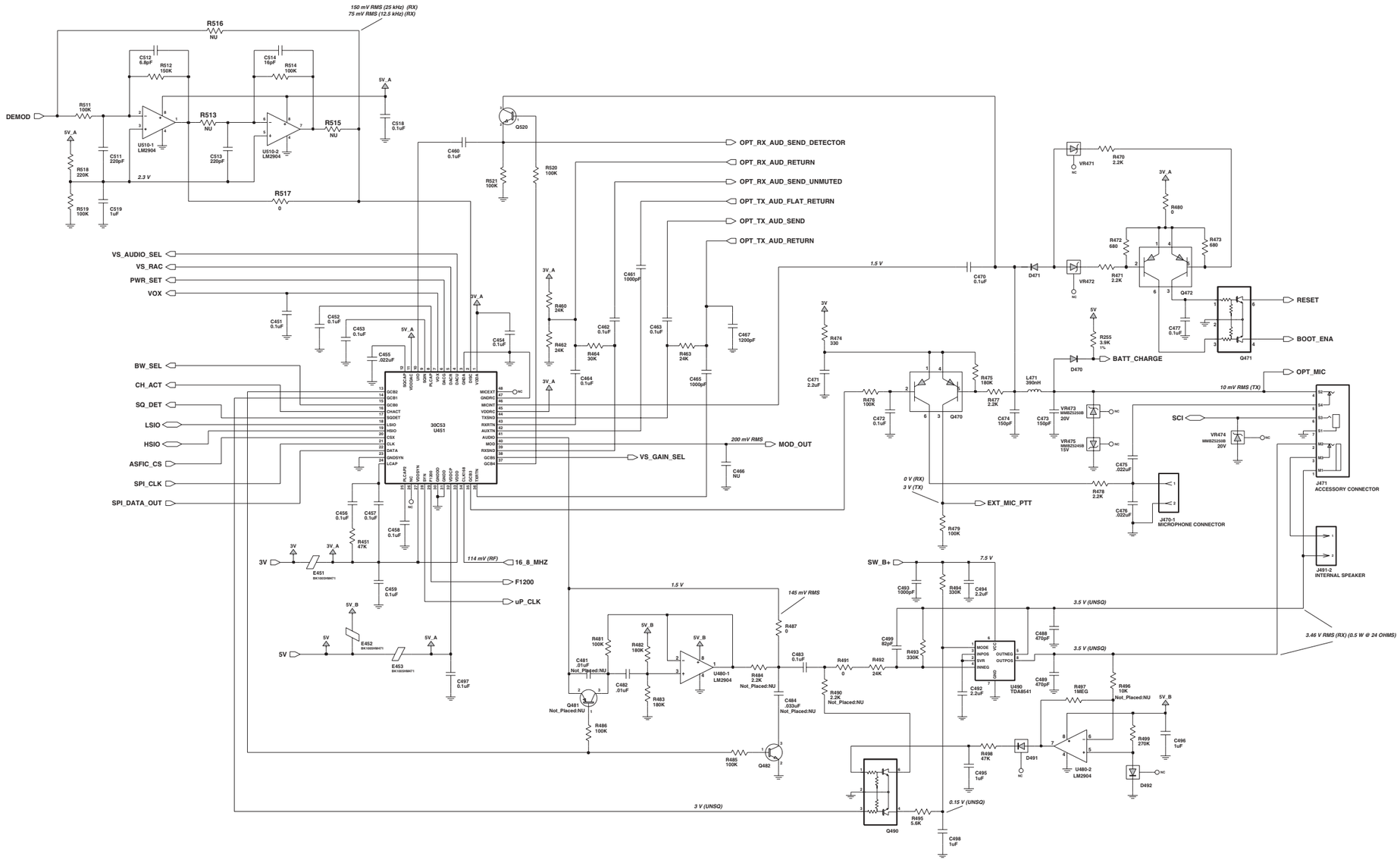


Figure 7-35. VHF (146-174 MHz) Audio Circuitry Schematic Diagram (8486342Z09-A)

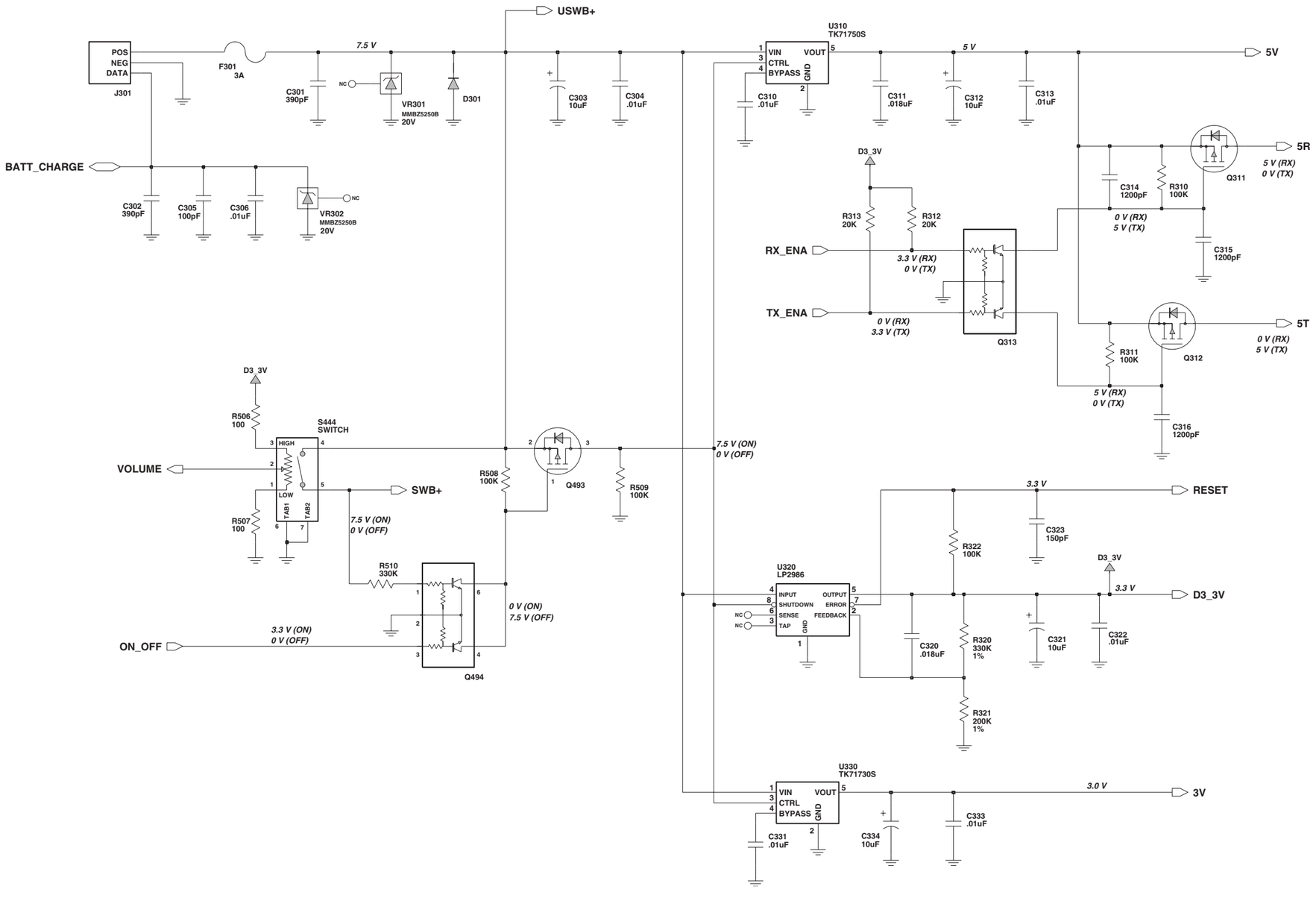


Figure 7-36. VHF (146-174 MHz) DC Regulation Schematic Diagram (8486342Z09-A)

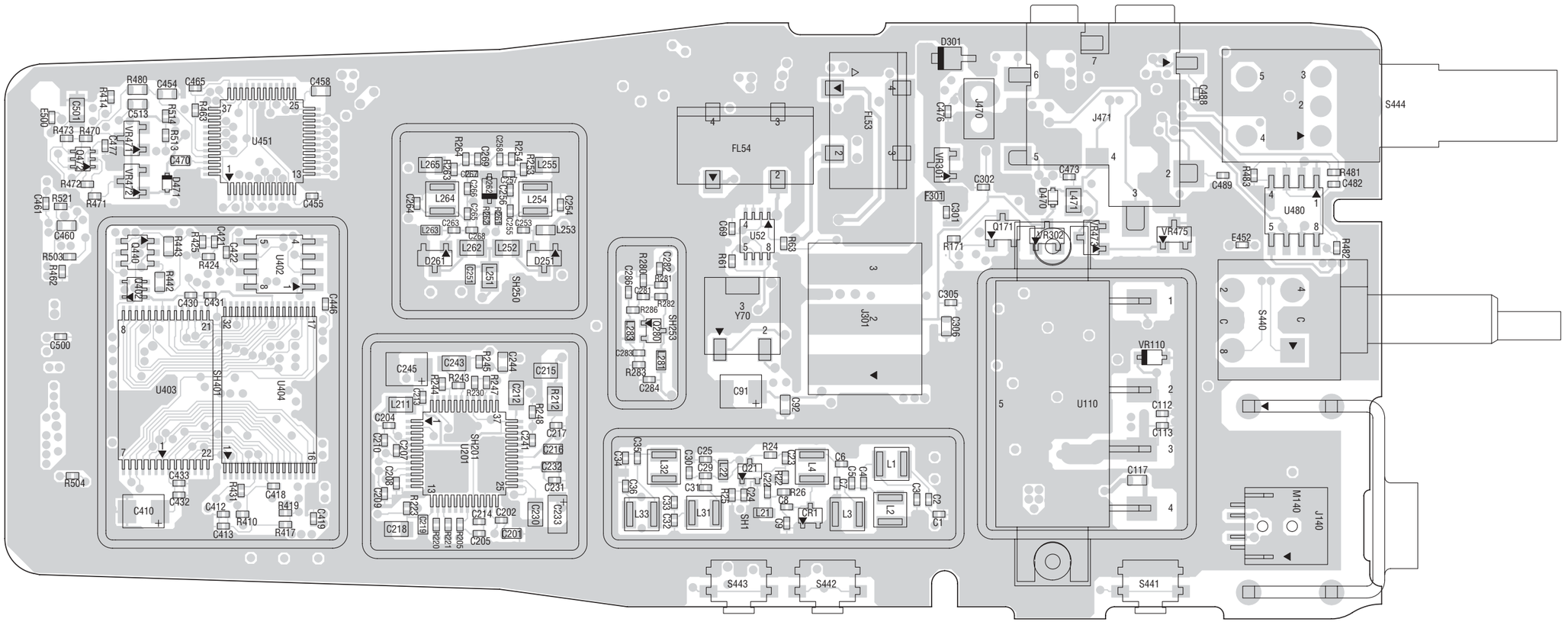


Figure 7-37. VHF (146-174 MHz) Board Component Side View (8486342Z09-A)

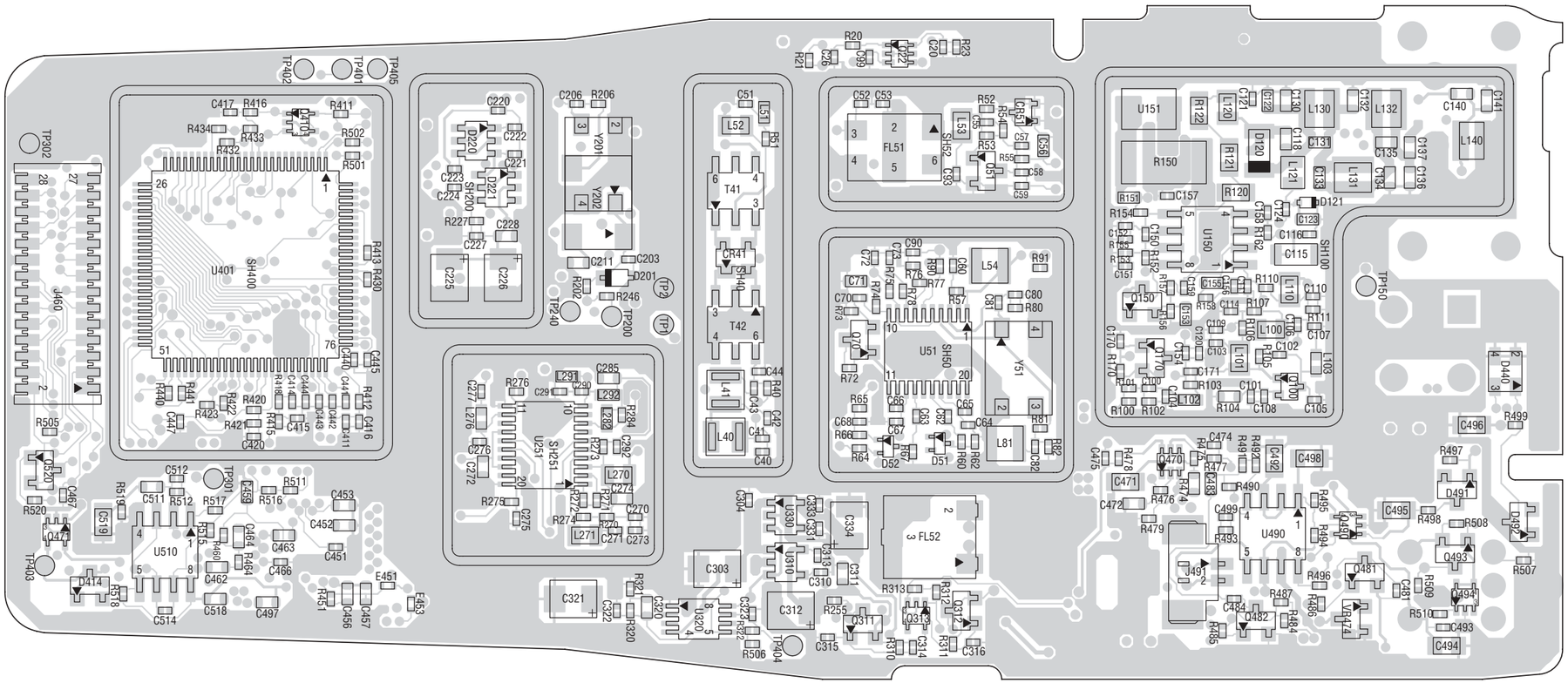


Figure 7-38. VHF (146-174 MHz) Board Solder Side View (8486342Z09-A)

VHF (146-174 MHz) Radio Parts List (8486342Z09-A)

Circuit Ref	Motorola Part No.	Description
C1	2109445U41	22 pF
C2	2109445U46	36 pF
C3	2109445U49	47 pF
C4	2109445U37	15 pF
C5	2109445U14	3.0 pF
C6	2109445U37	15 pF
C7	2109445U45	33 pF
C8	2109445U44	30 pF
C9		not used
C20	2113743L17	1000 pF
C22	2113743L17	1000 pF
C23	2113743L17	1000 pF
C24		not used
C25	2113743L17	1000 pF
C26	2113743L17	1000 pF
C29	2109445U48	43 pF
C30	2109445U42	24 pF
C31	2109445U44	30 pF
C32	2109445U51	56 pF
C33	2109445U42	24 pF
C34	2109445U51	56 pF
C35	2109445U43	27 pF
C36	2109445U42	24 pF
C40	2109445U40	20 pF
C41	2109445U37	15 pF
C42	2109445U46	36 pF
C43	2109445U37	15 pF
C44	2109445U40	20 pF
C51	2113743N48	82 pF
C52	2113743N32	18 pF
C53	2109445U26	9.1 pF
C55	2113743M24	0.1 uF
C56	2113743E20	0.1 uF
C57	2113743M24	0.1 uF
C58	2113743N16	3.9 pF
C59	2113743N12	2.7 pF
C60	2113743M24	0.1 uF
C62	2113743M24	0.1 uF
C63	2113743M24	0.1 uF
C64	2113743M24	0.1 uF
C65	2113743M24	0.1 uF
C66	2113743M24	0.1 uF
C67	2113743M24	0.1 uF
C68	2113743M24	0.1 uF
C69	2113743M24	0.1 uF
C70	2113743N53	130 pF
C71	2113743E20	0.1 uF
C72	2113743M24	0.1 uF
C73	2113743L33	4700 pF
C80	2109445U44	30 pF
C81	2109445U44	30 pF
C82		not used
C90	2113743M24	0.1 uF
C91	2311049A57	10 uF
C92	2113743E20	0.1 uF
C93	2113743N15	3.6 pF
C99	2113743M24	0.1 uF
C100	2113743L21	1500 pF
C101	2113743L21	1500 pF
C102	2113743M24	0.1 uF
C103	2113743L21	1500 pF
C104		not used
C105		not used
C106	2113743L21	1500 pF
C107	2113743N26	10 pF
C108	2113743M24	0.1 uF
C109	2113743M24	0.1 uF
C110	2113743M24	0.1 uF
C111		not used
C112	2113743L21	1500 pF
C113	2113743L21	1500 pF
C114	2113743L21	1500 pF
C115	2311049A07	1 uF
C116	2113743M24	0.1 uF
C117	2113741F25	1000 pF
C118		not used
C120	2113743L21	1500 pF
C121	2113743L21	1500 pF
C122	2113740F31	15 pF
C123	2113740F31	15 pF
C124	2113743L21	1500 pF
C130	2113740F29	12 pF
C131	2113740F15	3.3 pF
C132	2113740F37	27 pF
C133	2113740F15	3.3 pF
C134	2113740F37	27 pF
C135	2113740F17	3.9 pF
C136	2113740F30	13 pF
C137	2113740F58	200 pF
C140	2113740F30	13 pF
C141	2113740F33	18 pF
C150	2113743L21	1500 pF
C151	2113743L21	1500 pF
C152	2113743L21	1500 pF
C153	2113743K18	0.47 uF
C154	2113743L21	1500 pF
C155	2113743E20	0.1 uF
C156	2113743L41	.01 uF
C157	2113743M24	0.1 uF
C158	2113743L21	1500 pF
C159	2113743L21	1500 pF
C170	2113743L21	1500 pF
C171	2113743N12	2.7 pF
C201	2113740F59	220 pF
C202	2109445U52	62 pF
C203	2109445U13	2.7 pF
C204	2113743L09	470 pF
C205		not used
C206		not used
C207	2113743L09	470 pF
C208	2113743L09	470 pF
C209	2113743L09	470 pF
C210	2113743L09	470 pF
C211	2113743E20	0.1 uF
C212	2113743F18	2.2 uF
C213	2113743L41	.01 uF
C214	2113743L17	1000 pF
C215	2113743F18	2.2 uF
C216	2113743E20	0.1 uF
C217	2113743L17	1000 pF
C218	2113743F18	2.2 uF
C219	2113743E20	0.1 uF
C220	2113743N34	22 pF
C221	2113743L41	.01 uF
C222	2113743L41	.01 uF
C223	2113743L41	.01 uF
C224	2113743L41	.01 uF
C225	2311049A57	10 uF
C226	2311049A57	10 uF
C227	2113743L17	1000 pF
C228	2113743E20	0.1 uF
C230	2113743F18	2.2 uF
C231	2113743L17	1000 pF
C232	2113743E20	0.1 uF
C233	2311049A56	4.7 uF
C241	2113743L19	1200 pF
C243	2113741M69	0.1 uF
C244	2113741F27	1200 pF
C245	2311049A08	1 uF
C251	2113741F49	.01 uF
C253	2109445U38	16 pF
C254	2109445U15	3.3 pF
C255	2109445U39	18 pF
C256	2109445U27	10 pF
C257	2109445U46	36 pF
C258	2113743L19	1200 pF
C263	2109445U43	27 pF
C264	2109445U19	4.7 pF
C265	2109445U37	15 pF
C266	2109445U27	10 pF
C267	2109445U46	36 pF
C268	2109445U13	2.7 pF
C269	2113743L21	1500 pF
C270	2113743L19	1200 pF
C271	2113743L41	.01 uF
C272	2113743E20	0.1 uF
C273	2113743L41	.01 uF
C274	2113743E20	0.1 uF
C275	2113743L19	1200 pF
C276	2113743N19	5.1 pF
C277	2113743L19	1200 pF
C281	2113743L19	1200 pF
C282	2113743N25	9.1 pF
C283	2113743L19	1200 pF
C284	2113743L19	1200 pF
C285	2113743E20	0.1 uF
C286	2113743N27	11 pF
C290	2113743N43	51 pF
C291	2113743N39	36 pF
C292	2113743L19	1200 pF
C301	2113743L07	390 pF
C302	2113743L07	390 pF
C303	2311049A57	10 uF
C304	2113743L41	.01 uF
C305	2113743N50	100 pF
C306	2113741F49	.01 uF
C310	2113743L41	.01 uF
C311	2113743E05	.018 uF
C312	2311049A57	10 uF
C313	2113743L41	.01 uF
C314	2113743L19	1200 pF
C315	2113743L19	1200 pF
C316	2113743L19	1200 pF
C320	2113743E05	.018 uF
C321	2311049A57	10 uF
C322	2113743L41	.01 uF
C323	2113743N54	150 pF
C331	2113743L41	.01 uF
C333	2113743L41	.01 uF
C334	2311049A57	10 uF
C410	2311049A57	10 uF
C411	2113743M24	0.1 uF
C412	2113743L17	1000 pF
C413	2113743M24	0.1 uF
C414	2113743M24	0.1 uF
C415	2113743L17	1000 pF
C416	2113743L17	1000 pF
C417	2113743L17	1000 pF
C418	2113743M24	0.1 uF
C419	2113743L17	1000 pF
C420	2113743L41	.01 uF
C421	2113743L41	.01 uF
C422	2113743L41	.01 uF

Circuit Ref	Motorola Part No.	Description
C430	2113743M24	0.1 uF
C431	2113743L17	1000 pF
C432	2113743M24	0.1 uF
C433	2113743L17	1000 pF
C440	2113743L41	.01 uF
C441	2113743L41	.01 uF
C442	2113743L41	.01 uF
C443	2113743L41	.01 uF
C444	2113743L41	.01 uF
C445	2113743L41	.01 uF
C446	2113743L41	.01 uF
C447	2113743M24	0.1 uF
C451	2113743M24	0.1 uF
C452	2113743E20	0.1 uF
C453	2113743E20	0.1 uF
C454	2113743E20	0.1 uF
C455	2113743L48	.022 uF
C456	2113743E20	0.1 uF
C457	2113743E20	0.1 uF
C458	2113743E20	0.1 uF
C459	2113743E20	0.1 uF
C460	2113743E20	0.1 uF
C461	2113743L17	1000 pF
C462	2113743E20	0.1 uF
C463	2113743E20	0.1 uF
C464	2113743E20	0.1 uF
C465	2113743L17	1000 pF
C466		not used
C467	2113743L19	1200 pF
C470	2113743E20	0.1 uF
C471	2113743F18	2.2 uF
C472	2113743E20	0.1 uF
C473	2113743N54	150 pF
C474	2113743N54	150 pF
C475	2113743L48	.022 uF
C476	2113743L48	.022 uF
C477	2113743M24	0.1 uF
C481		not used
C482	2113743L41	.01 uF
C483	2113743E20	0.1 uF
C484		not used
C488	2113743L09	470 pF
C489	2113743L09	470 pF
C492	2113743F18	2.2 uF
C493	2113743L17	1000 pF
C494	2113743F18	2.2 uF
C495	2113743F16	1 uF
C496	2113743F16	1 uF
C497	2113743E20	0.1 uF
C498	2113743F16	1 uF
C499	2113743N48	82 pF

Circuit Ref	Motorola Part No.	Description
C500	2113743L17	1000 pF
C501	2113743F16	1 uF
C511	2113740F59	220 pF
C512	2113743N22	6.8 pF
C513	2113740F59	220 pF
C514	2113743N31	16 pF
C518	2113743E20	0.1 uF
C519	2113743F16	1 uF
CR1	4813825A19	dual Schottky, MMBD352
CR41	4886143B01	quad ring diode, SMS3927-99
CR51	4813825A19	dual Schottky, MMBD352
D51	4802245J97	dual silicon, DAN235ETL
D52	4802245J97	dual silicon, DAN235ETL
D120	4880973Z02	silicon PIN, MA4PH261
D121	4809948D12	silicon PIN, BAR_63-02W
D201	4862824C03	varactor, 1SV232
D220	4802233J09	triple diode, IMN10
D221	4802233J09	triple diode, IMN10
D251	4805649Q13	dual varactor, 1SV228
D261	4805649Q13	dual varactor, 1SV228
D262	4862824C01	varactor, 1SV229
D301	4813833A19	silicon, reverse polarity, MBRM120ET3
D414	4805129M41	Schottky, MMBD501
D440	4805729G49	dual LED red/green, BRPY1204W
D470	4809924D18	Schottky, RB520S-30
D471	4809924D18	Schottky, RB520S-30
D491	4805129M41	Schottky, MMBD501
D492	4805129M41	Schottky, MMBD501
E451	2480640Z01	bead, BK1005HM471
E452	2480640Z01	bead, BK1005HM471
E453	2480640Z01	bead, BK1005HM471
E500	2480640Z01	bead, BK1005HM471
F301	6580542Z01	fuse, 3 amp
FL51	9180022M11	4-pole crystal filter, 44.85 MHz
FL52	9180468V05	4-pole ceramic filter, 455 kHz, CFU455E
FL53	9180469V05	6-pole ceramic filter, 455 kHz, CFWC455E
FL54	9180469V03	6-pole ceramic filter, 455 kHz, CFWC455G
J140	0986428Z01	connector, external antenna
J301	0986565Z01	battery contact assembly
J460		not used
J470	0985818A01	connector, 2-pin, internal mic
J471	0980683Z03	connector, 2.5 / 3.5 mm, accessories
J491	0909897T04	connector, 2-pin, internal spkr
L1	2413923C09	68 nH
L2	2413923C09	68 nH

Circuit Ref	Motorola Part No.	Description
L3	2413923C09	68 nH
L4	2413923C09	68 nH
L21		not used
L22	2413926N24	100 nH
L31	2413923C09	68 nH
L32	2413923C09	68 nH
L33	2413923C09	68 nH
L40	2413923C09	68 nH
L41	2413923C09	68 nH
L51	2413926N26	150 nH
L52	2413926K32	560 nH
L53	2413926K33	680 nH
L54	2413923A25	1.2 uH
L81		not used
L100	2413926K32	560 nH
L101	2413926K32	560 nH
L102	2409377M17	100 nH
L103	2409377M31	30 nH
L110	2413926K32	560 nH
L120	2413926K32	560 nH
L121	2462587V30	47 nH
L130	2479990N01	43.67 nH
L131	2479990N01	43.67 nH
L132	2479990N01	43.67 nH
L140	2479990M01	30.54 nH
L211	2413926K32	560 nH
L251	2413926K32	560 nH
L252	2413926K32	560 nH
L253	2409377M17	100 nH
L254	2413923C05	33 nH
L255	2413926K29	330 nH
L262	2413926K32	560 nH
L263	2409377M17	100 nH
L264	2413923C07	47 nH
L265	2413926K29	330 nH
L270	2413926K32	560 nH
L271		not used
L276	2413926N24	100 nH
L281	2413926N22	68 nH
L282	2413926N20	47 nH
L283		not used
L291	2413926N17	27 nH
L292	2413926N22	68 nH
L471	2413926K30	390 nH
M140	0286427Z01	antenna nut
Q21	4802245J95	silicon NPN, BFS540
Q22	4805723X02	dual silicon PNP, UMT1
Q51	4802197J95	silicon NPN, PBR941
Q70	4880214G02	silicon NPN, MMBT3904
Q100	4802245J95	silicon NPN, BFS540
Q150	4880214G02	silicon NPN, MMBT3904

Circuit Ref	Motorola Part No.	Description
Q170	4809579E18	P-channel MOSFET, TP0101T
Q171	4880048M01	digital NPN, DTC144EKA
Q280	4802245J95	silicon NPN, BFS540
Q311	4809579E18	P-channel MOSFET, TP0101T
Q312	4809579E18	P-channel MOSFET, TP0101T
Q313	4802245J54	dual digital NPN, UMG5
Q402	4809939C05	dual digital NPN/PNP, UMC5NTL
Q410	4802245J54	dual digital NPN, UMG5
Q440	5180159R01	dual NPN, IMX1
Q470	4805723X02	dual silicon PNP, UMT1
Q471	4802245J54	dual digital NPN, UMG5
Q472	4805723X02	dual silicon PNP, UMT1
Q481		not used
Q482	4813824A10	silicon NPN, MMBT3904
Q490	4802245J54	dual digital NPN, UMG5
Q493	4809579E18	P-channel MOSFET, TP0101T
Q494	4802245J54	dual digital NPN, UMG5
Q520	4813824A10	silicon NPN, MMBT3904
R20	0662057U97	6.8K
R21	0662057M54	150
R22	0662057M94	6.8K
R23	0662057V11	22K
R24	0662057M71	750
R25	0662057M92	5.6K
R26	0662057M01	0
R40	0662057M74	1K
R51	0662057M43	51
R52	0662057N01	12K
R53	0662057N11	33K
R54	0662057M90	4.7K
R55	0662057M62	330
R57	0662057M90	4.7K
R60	0662057M83	2.4K
R61	0662057N23	100K
R62	0662057M86	3.3K
R63	0662057N13	39K
R64	0662057N06	20K
R65	0662057N13	39K
R66	0662057N06	20K
R67	0662057N06	20K
R72	0662057M64	390
R73	0662057M80	1.8K
R74	0662057M76	1.2K
R75	0662057N01	12K
R76	0662057V04	12K
R77	0662057U99	8.2K
R78	0662057M70	680
R80	0662057N03	15K
R81		not used
R82	0662057M01	0

Circuit Ref	Motorola Part No.	Description
R90	0662057M43	51
R91	0662057M79	1.6K
R100	0662057M61	300
R101	0662057M32	18
R102	0662057M61	300
R103	0662057M86	3.3K
R104	0662057A18	51
R105	0662057M76	1.2K
R106	0662057M90	4.7K
R107	0662057M54	150
R110	0662057M72	820
R111	0662057M84	2.7K
R120	0662057C41	39
R121	0662057C41	39
R122	0662057C41	39
R150	0680539Z01	0.1
R151	0662057A09	22
R152	0662057V27	100K
R153	0662057V27	100K
R154	0662057V27	100K
R155	0662057V27	100K
R156	0662057M62	330
R157	0662057M92	5.6K
R158	0662057M78	1.5K
R162	0662057M98	10K
R170	0662057N23	100K
R171	0662057N07	22K
R202	0662057N27	150K
R205	0662057M50	100
R206		not used
R212	0662057C01	0
R220	0662057M54	150
R221	0662057M54	150
R223	0662057M50	100
R227	0662057N27	150K
R230	0662057N30	200K
R243	0662057M81	2K
R244	0662057M43	51
R245	0662057M78	1.5K
R246	0662057N23	100K
R247	0662057N33	270K
R248	0662057M43	51
R253	0662057M42	47
R254	0662057M58	220
R255	0662057U91	3.9K
R261	0662057N16	51K
R262	0662057M94	6.8K
R263	0662057M37	30
R264	0662057M58	220
R270	0662057M32	18
R271	0662057M96	8.2K
R272	0662057M97	9.1K
R273	0662057M61	300
R274	0662057M38	33
R275	0662057M01	0
R276	0662057M74	1K
R280	0662057M94	6.8K
R281	0662057M97	9.1K
R282	0662057M71	750
R283	0662057M56	180
R284	0662057M62	330
R286	0662057M01	0
R310	0662057N23	100K
R311	0662057N23	100K
R312	0662057N06	20K
R313	0662057N06	20K
R320	0662057V43	330K
R321	0662057V35	200K
R322	0662057N23	100K
R410	0662057M98	10K
R411	0662057M72	820
R412	0662057N23	100K
R413	0662057N23	100K
R414	0662057N11	33K
R415	0662057N11	33K
R416	0662057N06	20K
R417	0662057M98	10K
R418	0662057N23	100K
R419	0662057M90	4.7K
R420	0662057V35	200K
R421	0662057V27	100K
R422	0662057N23	100K
R423	0662057N23	100K
R424	0662057V35	200K
R425	0662057V27	100K
R430	0662057N23	100K
R431		not used
R432	0662057M01	0
R433	0662057N23	100K
R434		not used
R440	0662057M90	4.7K
R441	0662057M90	4.7K
R442	0662057A33	220
R443	0662057A27	120
R451	0662057N15	47K
R460	0662057N08	24K
R462	0662057N08	24K
R463	0662057N08	24K
R464	0662057N10	30K
R470	0662057M82	2.2K
R471	0662057M82	2.2K
R472	0662057M70	680
R473	0662057M70	680
R474	0662057A37	330
R475	0662057N29	180K
R476	0662057N23	100K
R477	0662057M82	2.2K
R478	0662057M82	2.2K
R479	0662057N23	100K
R480	0662057B47	0
R481	0662057N23	100K
R482	0662057N29	180K
R483	0662057N29	180K
R484		not used
R485	0662057N23	100K
R486	0662057N23	100K
R487	0662057M01	0
R490		not used
R491	0662057M01	0
R492	0662057N08	24K
R493	0662057N35	330K
R494	0662057V43	330K
R495	0662057M92	5.6K
R496		not used
R497	0662057N47	1MEG
R498	0662057N15	47K
R499	0662057N33	270K
R501	0662057M50	100
R502	0662057M50	100
R503	0662057M50	100
R504	0662057M50	100
R505	0662057M50	100
R506	0662057M50	100
R507	0662057M50	100
R508	0662057N23	100K
R509	0662057N23	100K
R510	0662057N35	330K
R511	0662057N23	100K
R512	0662057N27	150K
R513		not used
R514	0662057N23	100K
R515		not used
R516		not used
R517	0662057M01	0
R518	0662057N31	220K
R519	0662057N23	100K
R520	0662057N23	100K
R521	0662057N23	100K
S440	4080710Z22	switch, rotary, 16 channel select
	or 4080710Z13	switch, rotary, 4 channel select
S441	4070354A01	pushbutton switch, PTT
S442	4070354A01	pushbutton switch, side option (lower)
S443	4070354A01	pushbutton switch, side option (upper)
S444	1880619Z02	switch, rotary on-off, with 10K volume control
SH1	2686421Z01	shield, comp side, RF front end
SH40	2686419Z01	shield, solder side, first mixer
SH50	2686423Z01	shield, solder side, IFIC and 2nd LO crystal
SH52	2686424Z01	shield, solder side, high IF crystal filter
SH100	2686418Z01	shield, solder side, transmitter
SH200	2686424Z01	shield, solder side, synthesizer charge pump
SH201	2686423Z01	shield, com side, synthesizer
SH250	2686425Z01	shield, comp side, VCO tank circuits
SH251	2686425Z01	shield, solder side, VCOBIC
SH253	2686422Z01	shield, comp side, VCO RX injection buffer
SH400	2686420Z01	shield, solder side, microprocessor
SH401	2686420Z01	shield, comp side, memory
T41	2580541Z02	transformer, balun
T42	2580541Z02	transformer, balun
U51	5186144B01	receiver system (IFIC), SA616
U52	5109522E10	triple inverter, TC7W04F
U110	5102466J03	transmitter PA module, RA07M1317M_VHF
U150	5113818A01	dual opamp, LM2904
U151	2484657R01	bead
U201*	5185963A27	frequency synthesizer
U251	5105750U54	VCO/buffer
U310	5102478J01	5V voltage regulator, TK71750S
U320	5185963A55	adjustable voltage regulator w/ reset, LP2986
U330	5102479J01	3V voltage regulator, TK71730S
U401*	5102226J56	microprocessor, MC68HC11FL0
U402*	5102463J64	serial EEPROM 16Kx8, AT25128
U403		not used
U404*	5102480J01	Flash ROM 128Kx8, AT49LV001N_70V
U451	5185130C53	audio filter (ASFIC_cmp)
U480	5113818A01	dual opamp, LM2904

Circuit Ref	Motorola Part No.	Description
U490	5108858K99	audio power amplifier, TDA8541
U510	5113818A01	dual opamp, LM2904
VR110		not used
VR301	4813830A33	zener diode, 20V, MMBZ5250B
VR302	4813830A33	zener diode, 20V, MMBZ5250B
VR471	4813830A18	zener diode, 6.8V, MMBZ5235B
VR472	4813830A09	zener diode, 3.3V, MMBZ5226B
VR473	4813830A33	zener diode, 20V, MMBZ5250B
VR474	4813830A33	zener diode, 20V, MMBZ5250B
VR475	4880140L20	zener diode, 15V, MMBZ5245B
Y51	4880606B09	crystal, 44.395 MHz
Y70	9186145B02	ceramic discriminator, 455 kHz
Y201*	4880114R06	crystal, 16.8 MHz
Y202		not used

* Motorola Depot Servicing only

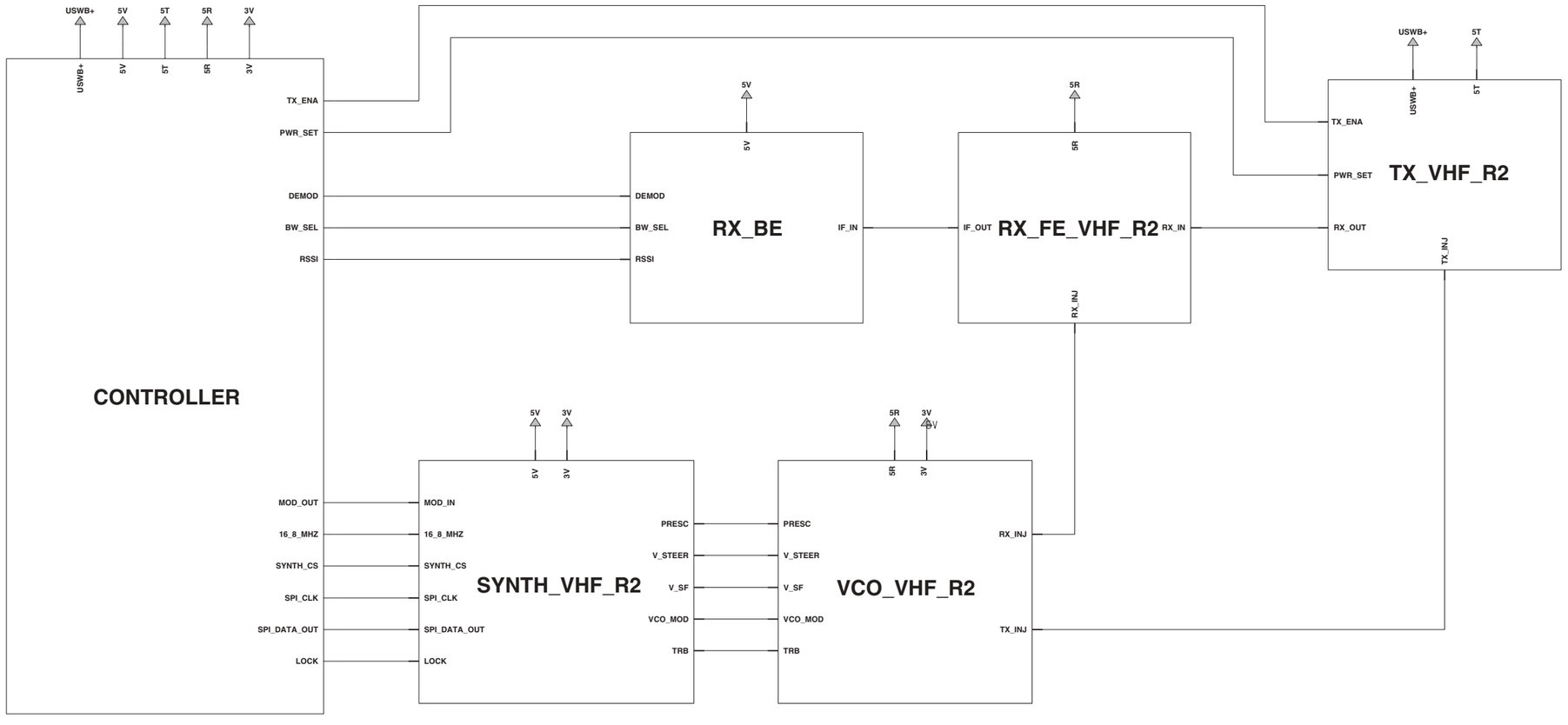


Figure 7-39. VHF (146-174 MHz) Radio Circuit Block Interconnect Diagram (8486342Z13-C)

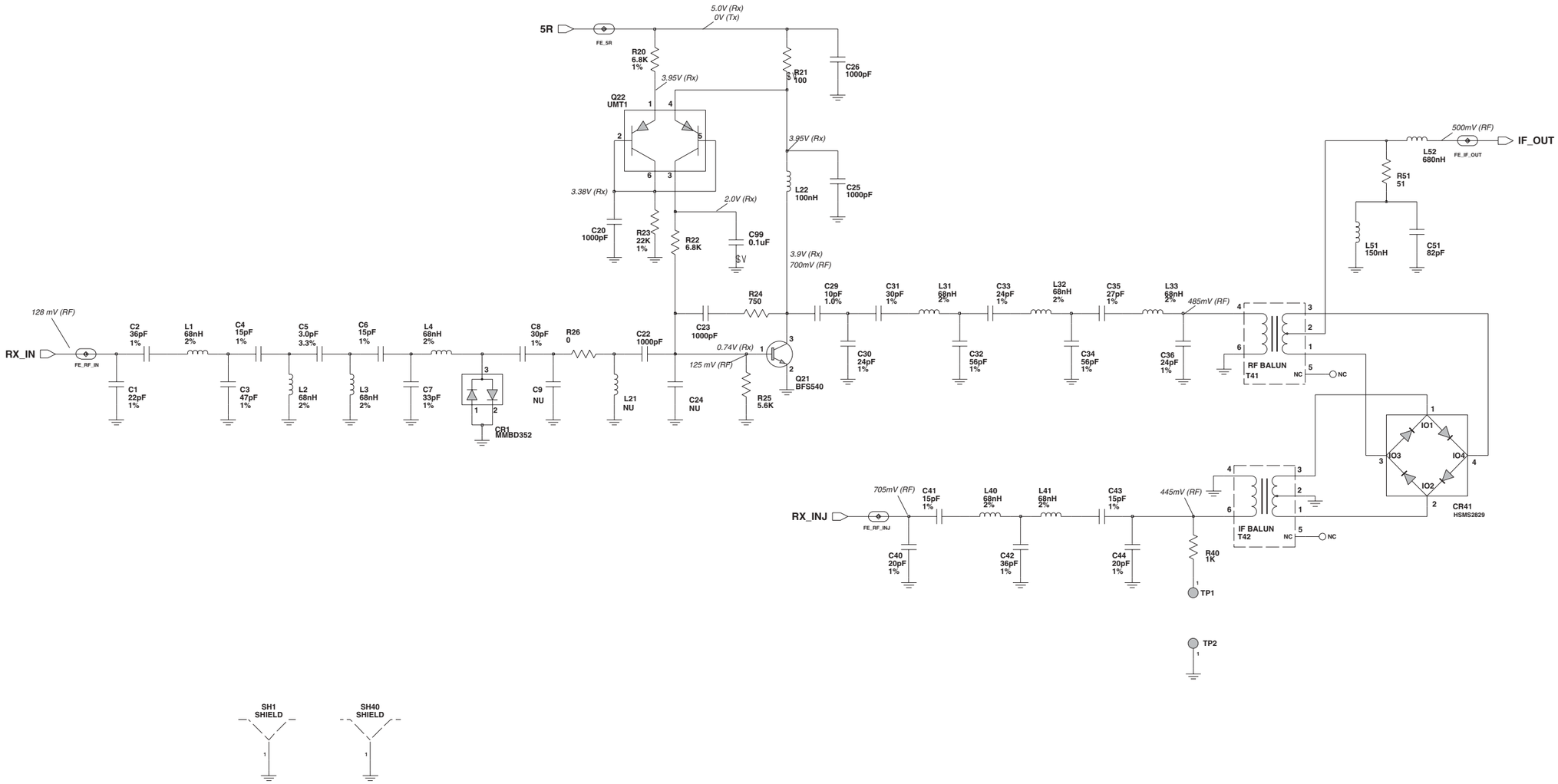


Figure 7-40. VHF (146-174 MHz) Receiver Front End Schematic Diagram (8486342Z13-C)

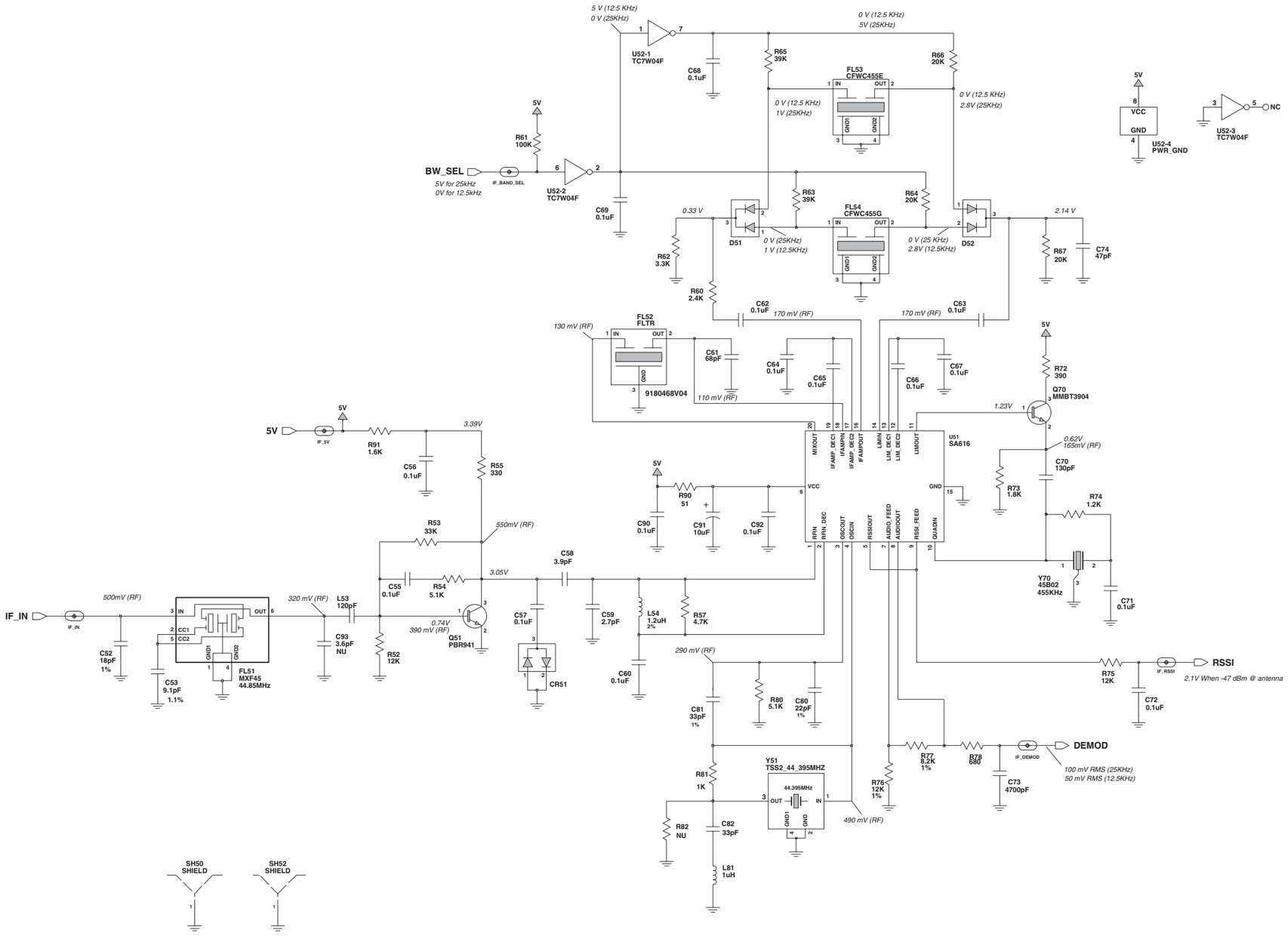
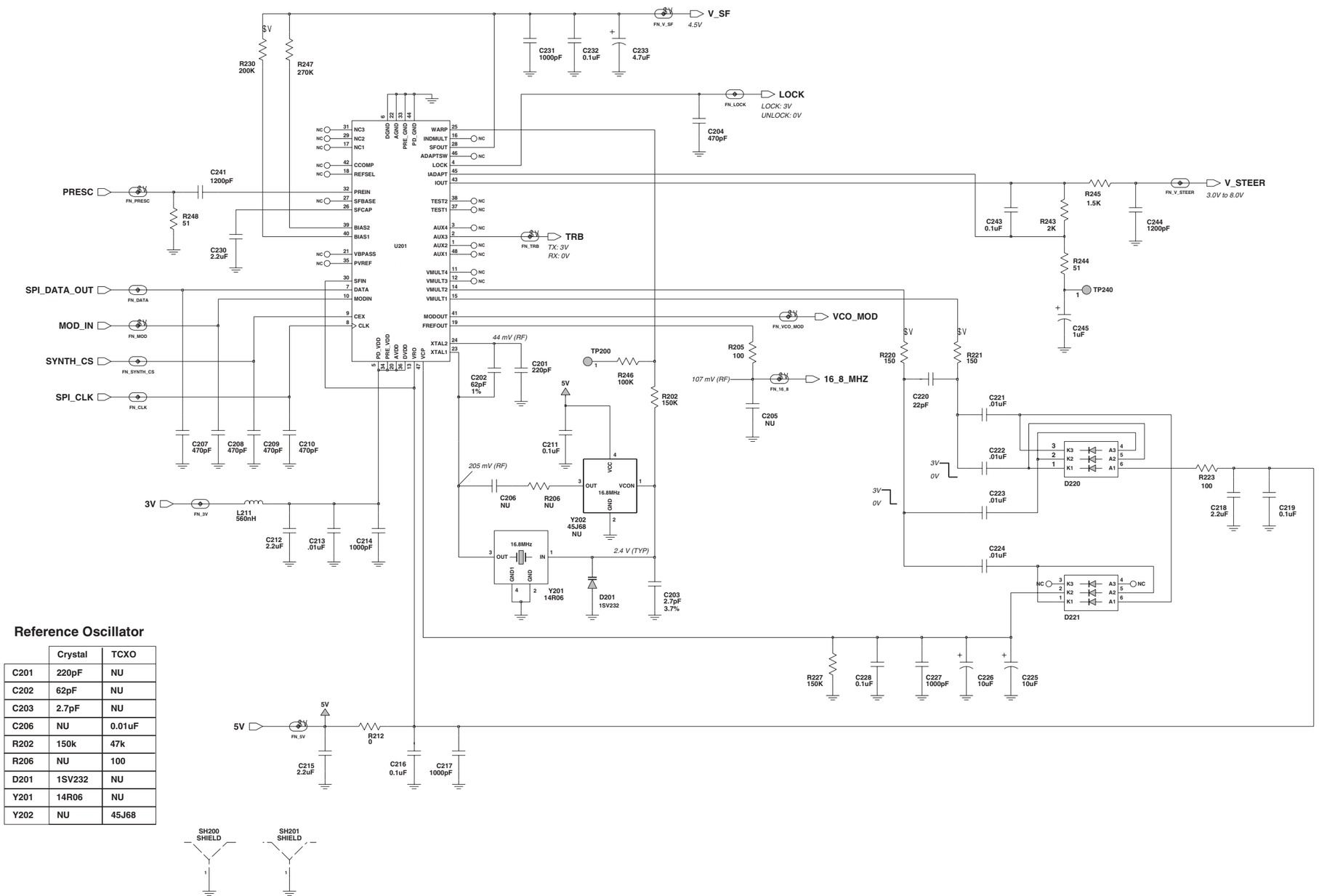


Figure 7-41. VHF (146-174 MHz) Receiver Back End Schematic Diagram (8486342Z13-C)



Reference Oscillator

	Crystal	TCXO
C201	220pF	NU
C202	62pF	NU
C203	2.7pF	NU
C206	NU	0.01uF
R202	150k	47k
R206	NU	100
D201	1SV232	NU
Y201	14R06	NU
Y202	NU	45J68

Figure 7-42. VHF (146-174 MHz) Synthesizer Schematic Diagram (8486342Z13-C)

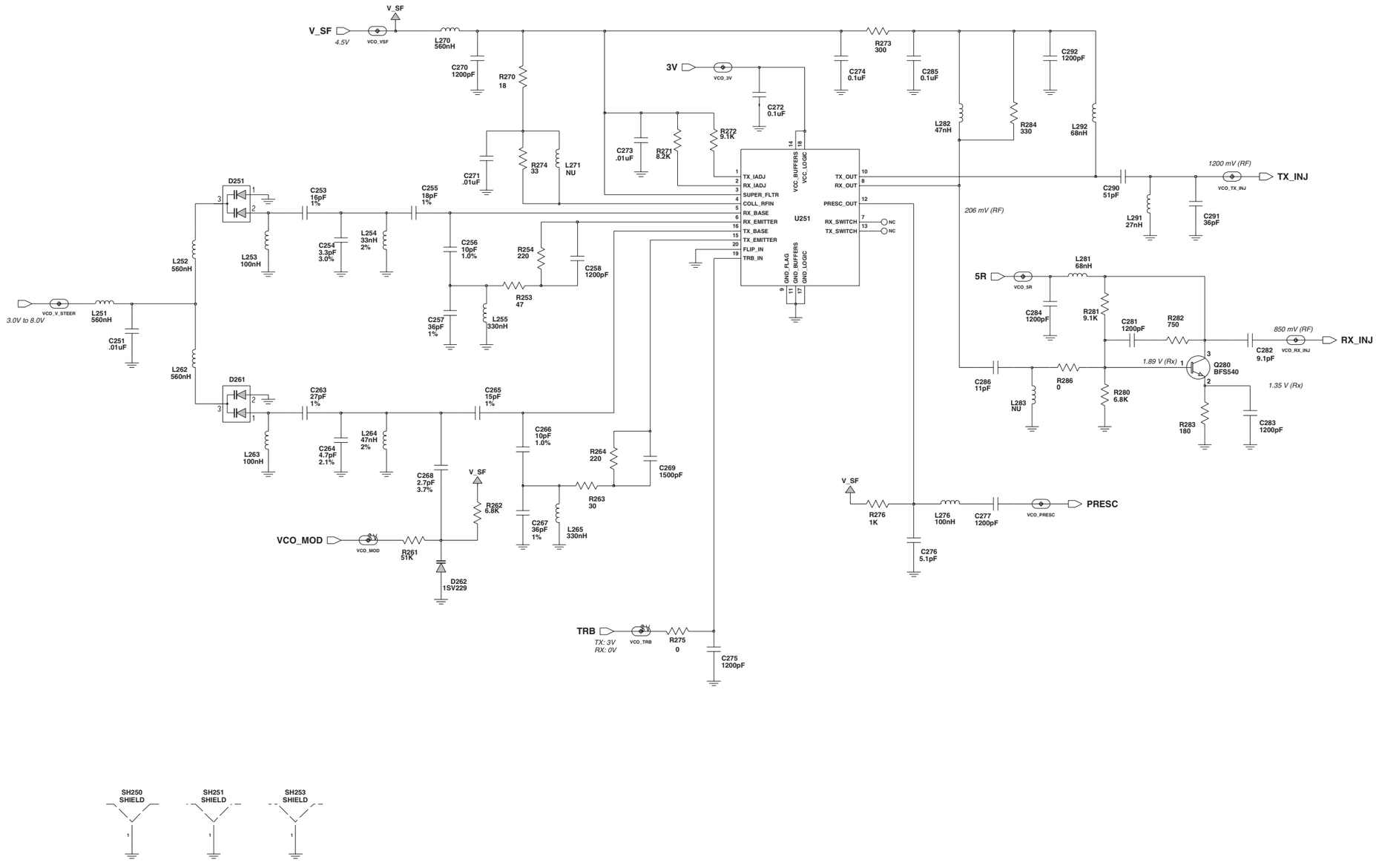


Figure 7-43. VHF (146-174 MHz) Voltage Controlled Oscillator Schematic Diagram (8486342Z13-C)

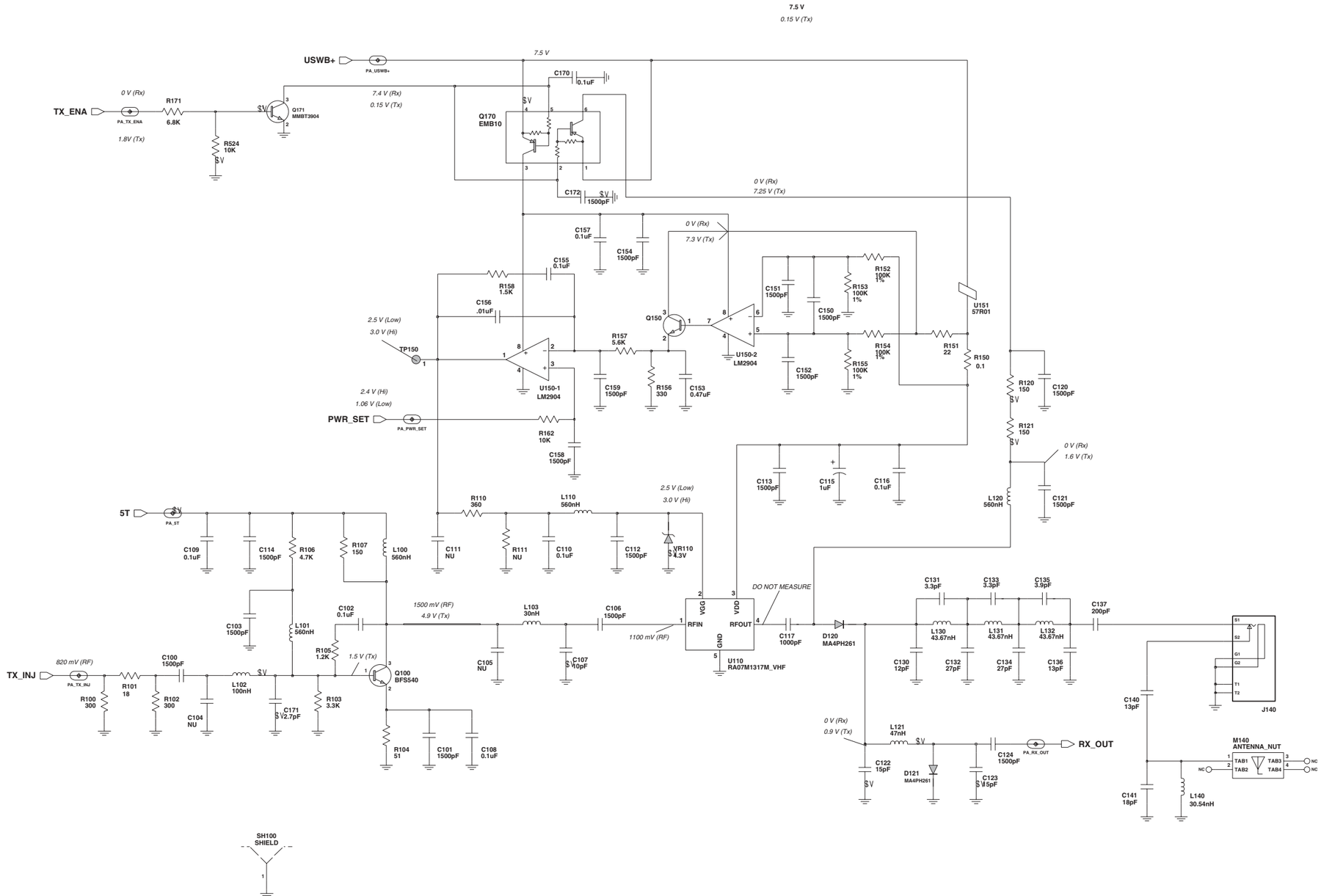


Figure 7-44. VHF (146-174 MHz) Transmitter and Power Control Schematic Diagram (8486342Z13-C)

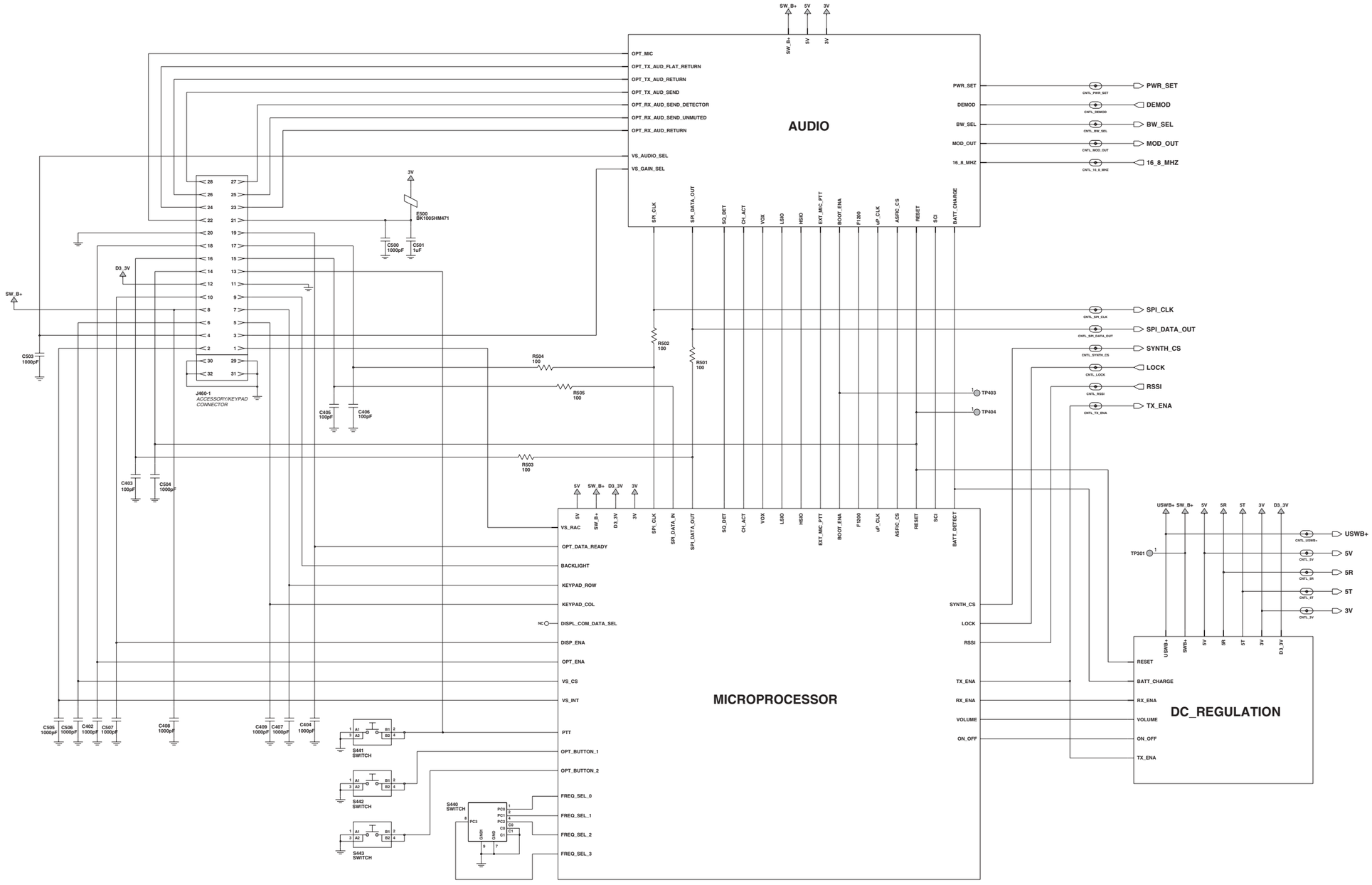


Figure 7-45. VHF (146-174 MHz) Controller Interconnect Schematic Diagram (8486342Z13-C)

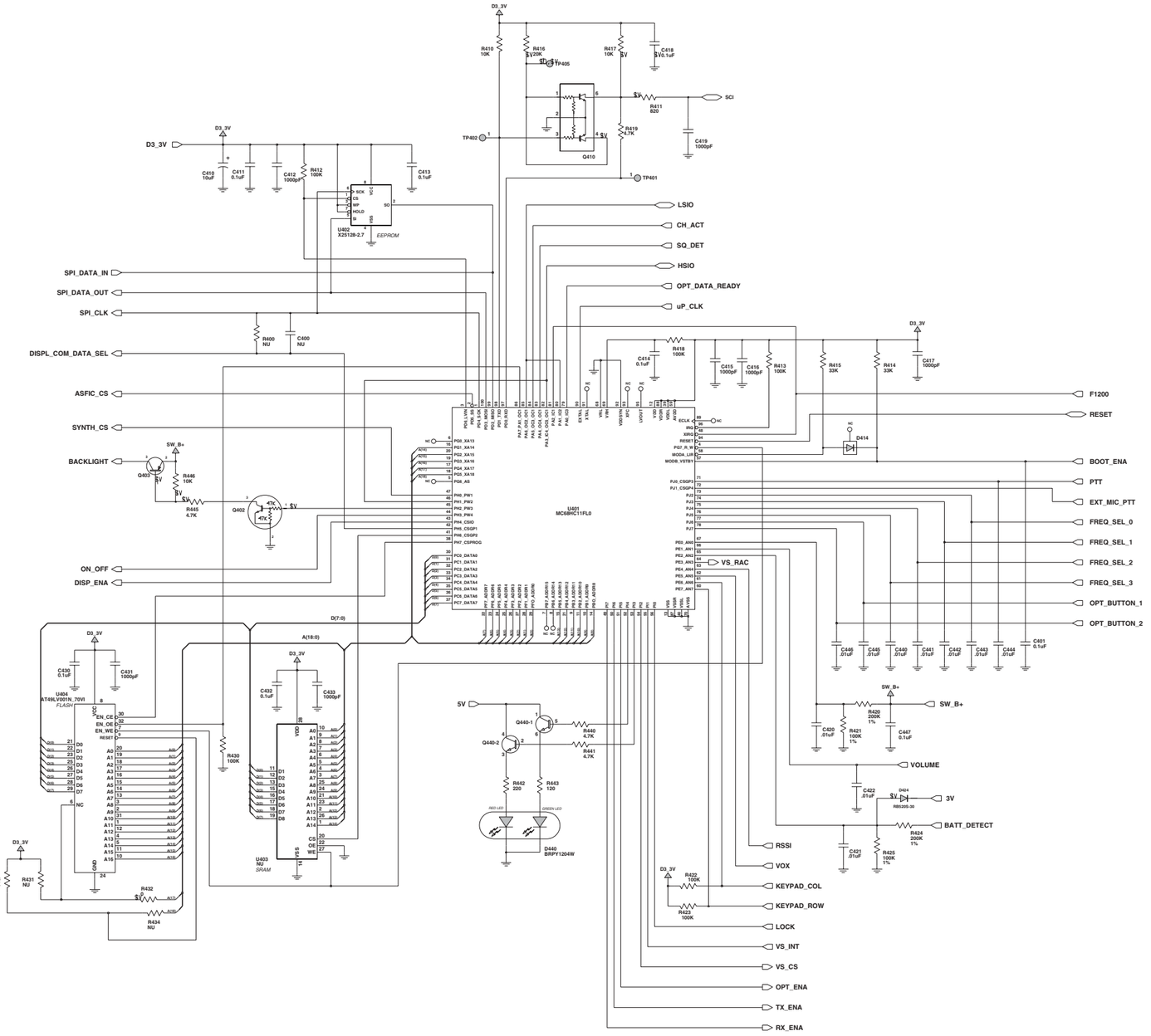
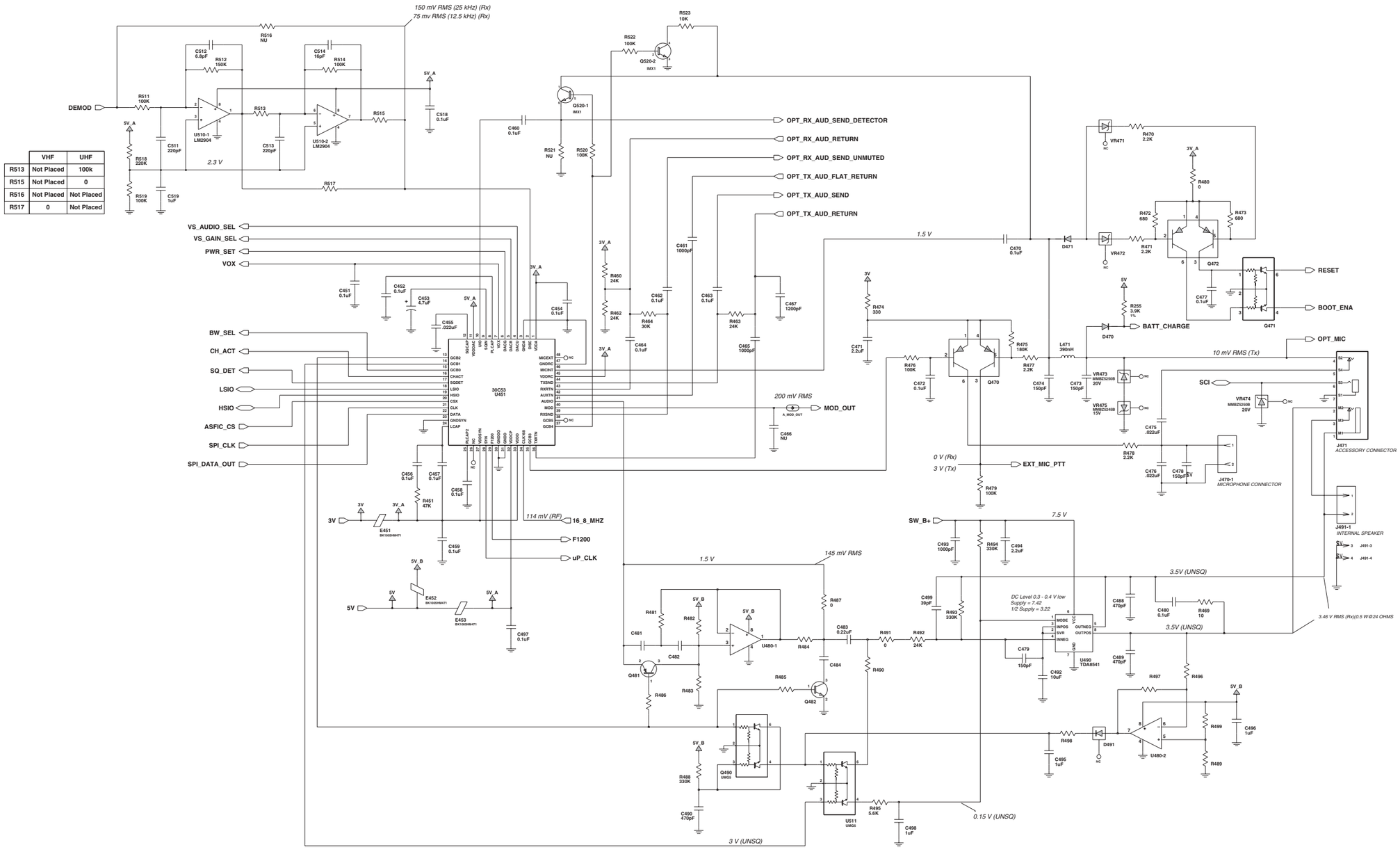


Figure 7-46. VHF (146-174 MHz) Microprocessor Circuitry Schematic Diagram (8486342Z13-C)



	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

Figure 7-47. VHF (146-174 MHz) Audio Circuitry Schematic Diagram (8486342Z13-C)

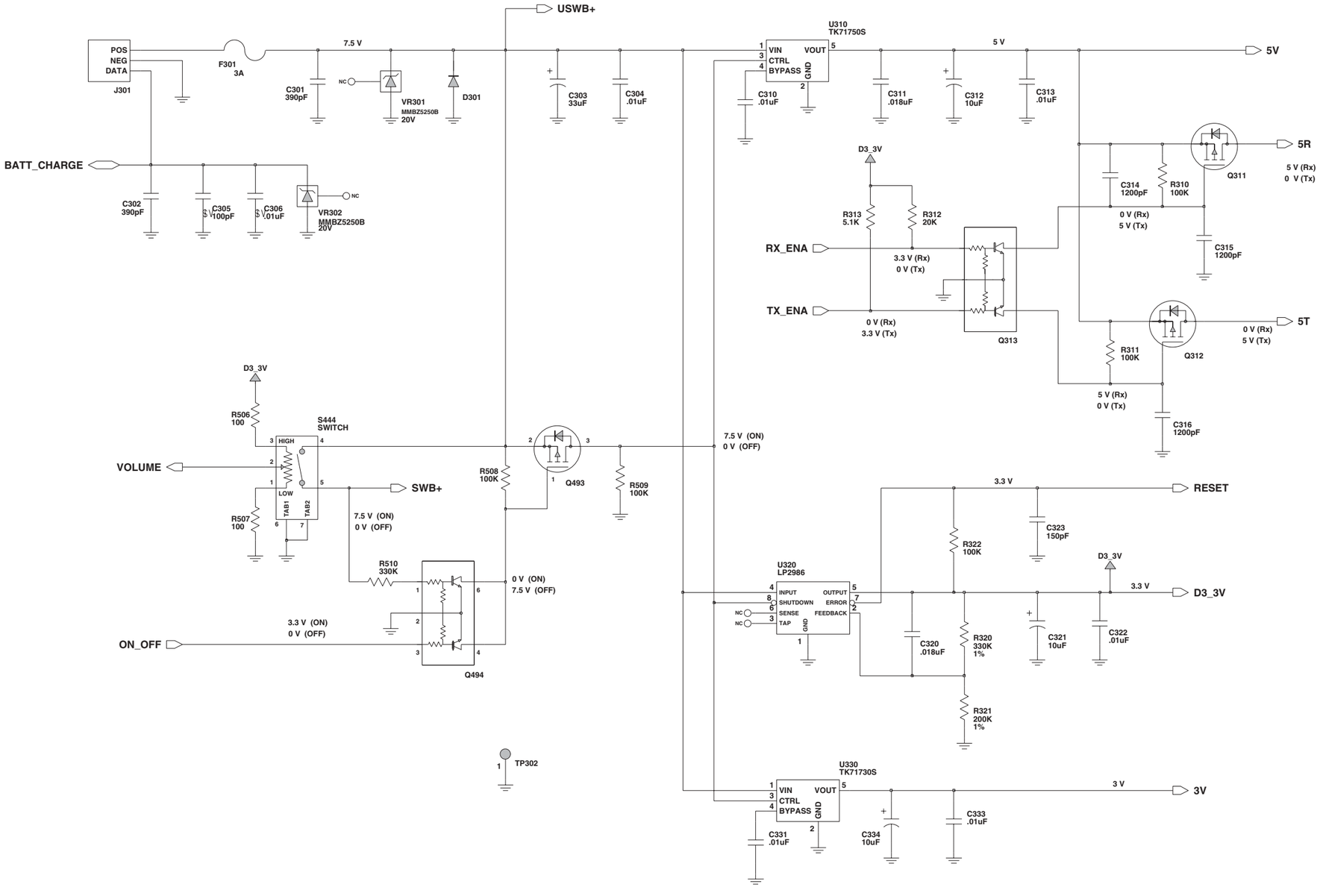


Figure 7-48. VHF (146-174 MHz) DC Regulation Schematic Diagram (8486342Z13-C)

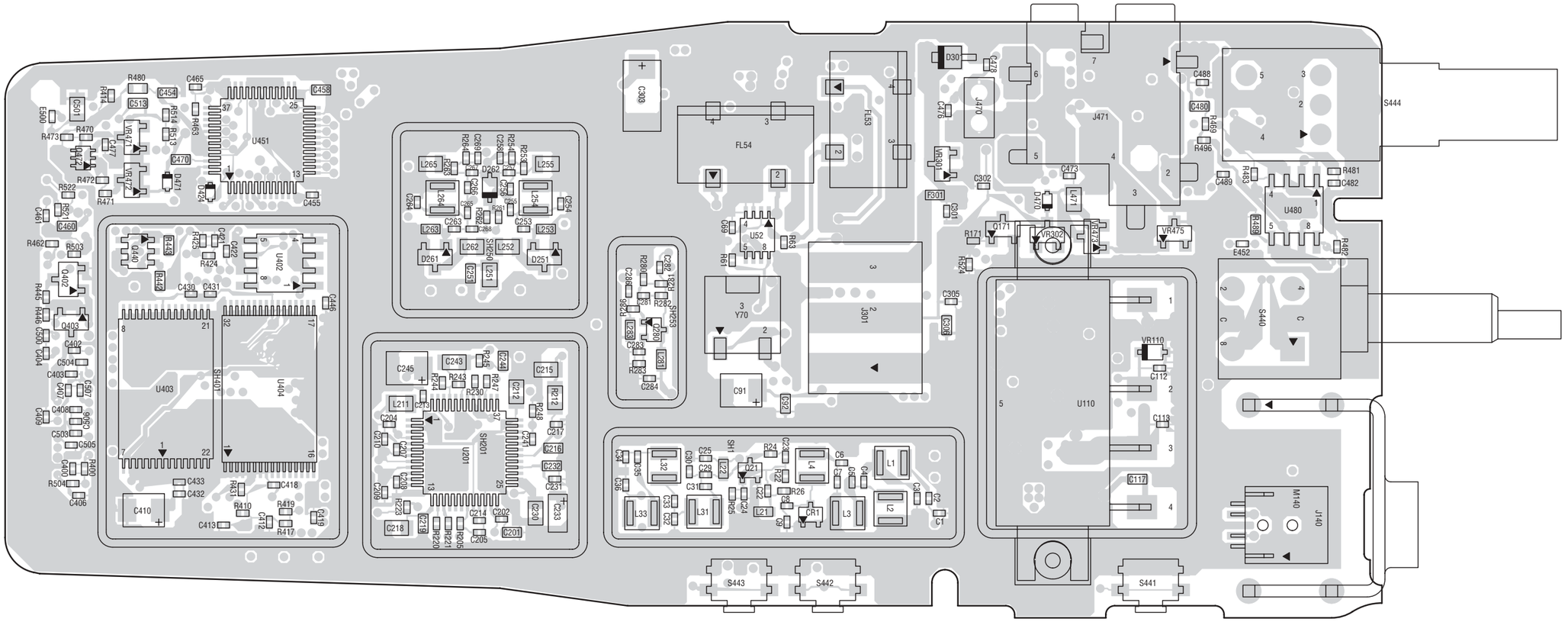


Figure 7-49. VHF (146-174 MHz) Board Component Side View (8486342Z13-C)

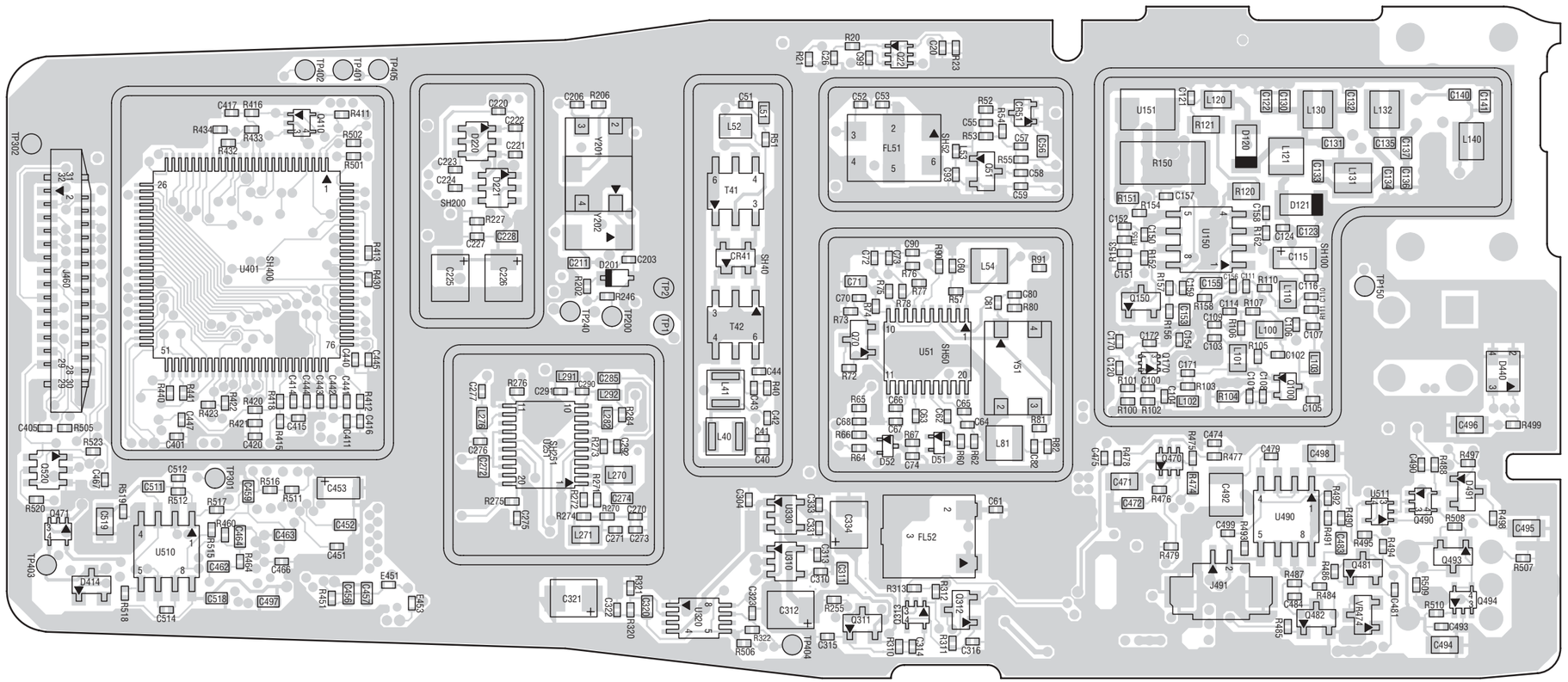


Figure 7-50. VHF (146-174 MHz) Board Solder Side View (8486342Z13-C)

VHF (146-174 MHz) Radio Parts List (8486342Z13-C)

Circuit Ref	Motorola Part No.	Description
C1	2109445U41	CAP, 22pF
C2	2109445U46	CAP, 36pF
C3	2109445U49	CAP, 47pF
C4	2109445U37	CAP, 15pF
C5	2109445U14	CAP, 3.0pF
C6	2109445U37	CAP, 15pF
C7	2109445U45	CAP, 33pF
C8	2109445U44	CAP, 30pF
C9	Not_Placed	CAP, 4.7pF
C20	2113743L17	CAP, 1000pF
C22	2113743L17	CAP, 1000pF
C23	2113743L17	CAP, 1000pF
C24	Not_Placed	CAP, 6.2pF
C25	2113743L17	CAP, 1000pF
C26	2113743L17	CAP, 1000pF
C29	2109445U27	CAP, 10pF
C30	2109445U42	CAP, 24pF
C31	2109445U44	CAP, 30pF
C32	2109445U51	CAP, 56pF
C33	2109445U42	CAP, 24pF
C34	2109445U51	CAP, 56pF
C35	2109445U43	CAP, 27pF
C36	2109445U42	CAP, 24pF
C40	2109445U40	CAP, 20pF
C41	2109445U37	CAP, 15pF
C42	2109445U46	CAP, 36pF
C43	2109445U37	CAP, 15pF
C44	2109445U40	CAP, 20pF
C51	2113743N48	CAP, 82pF
C52	2109445U39	CAP, 18pF
C53	2109445U26	CAP, 9.1pF
C55	2113743M24	CAP, 0.1uF
C56	2113743E20	CAP, 0.1uF
C57	2113743M24	CAP, 0.1uF
C58	2113743N16	CAP, 3.9pF
C59	2113743N12	CAP, 2.7pF
C60	2113743M24	CAP, 0.1uF
C61	2113743N46	CAP, 68pF
C62	2113743M24	CAP, 0.1uF
C63	2113743M24	CAP, 0.1uF
C64	2113743M24	CAP, 0.1uF
C65	2113743M24	CAP, 0.1uF
C66	2113743M24	CAP, 0.1uF
C67	2113743M24	CAP, 0.1uF
C68	2113743M24	CAP, 0.1uF
C69	2113743M24	CAP, 0.1uF
C70	2113743N53	CAP, 130pF
C71	2113743E20	CAP, 0.1uF
C72	2113743M24	CAP, 0.1uF
C73	2113743L33	CAP, 4700pF
C74	2113743N42	CAP, 47pF
C80	2109445U41	CAP, 22pF
C81	2109445U45	CAP, 33pF
C82	2109445U45	CAP, 33pF
C90	2113743M24	CAP, 0.1uF
C91	2311049A57	CAPP, 10uF
C92	2113743E20	CAP, 0.1uF
C93	Not_Placed	CAP, 3.6pF
C99	2113743M24	CAP, 0.1uF
C100	2113743L21	CAP, 1500pF
C101	2113743L21	CAP, 1500pF
C102	2113743M24	CAP, 0.1uF
C103	2113743L21	CAP, 1500pF
C104	Not_Placed	CAP, 27pF
C105	Not_Placed	CAP, 10pF
C106	2113743L21	CAP, 1500pF
C107	2113743N26	CAP, 10pF
C108	2113743M24	CAP, 0.1uF
C109	2113743M24	CAP, 0.1uF
C110	2113743M24	CAP, 0.1uF
C111	Not_Placed	CAP, 1500pF
C112	2113743L21	CAP, 1500pF
C113	2113743L21	CAP, 1500pF
C114	2113743L21	CAP, 1500pF
C115	2311049A07	CAPP, 1uF
C116	2113743M24	CAP, 0.1uF
C117	2113741F25	CAP, 1000pF
C120	2113743L21	CAP, 1500pF
C121	2113743L21	CAP, 1500pF
C122	2113740F31	CAP, 15pF
C123	2113740F31	CAP, 15pF
C124	2113743L21	CAP, 1500pF
C130	2113740F29	CAP, 12pF
C131	2113740F15	CAP, 3.3pF
C132	2113740F37	CAP, 27pF
C133	2113740F15	CAP, 3.3pF
C134	2113740F37	CAP, 27pF
C135	2113740F17	CAP, 3.9pF
C136	2113740F30	CAP, 13pF
C137	2113740F58	CAP, 200pF
C140	2113740F30	CAP, 13pF
C141	2113740F33	CAP, 18pF
C150	2113743L21	CAP, 1500pF
C151	2113743L21	CAP, 1500pF
C152	2113743L21	CAP, 1500pF
C153	2113743K18	CAP, 0.47uF
C154	2113743L21	CAP, 1500pF
C155	2113743E20	CAP, 0.1uF
C156	2113743L41	CAP, .01uF
C157	2113743M24	CAP, 0.1uF
C158	2113743L21	CAP, 1500pF
C159	2113743L21	CAP, 1500pF
C170	2113743M24	CAP, 0.1uF
C171	2113743N12	CAP, 2.7pF
C172	2113743L21	CAP, 1500pF
C201	2113740F59	CAP, 220pF
C202	2109445U52	CAP, 62pF
C203	2109445U13	CAP, 2.7pF
C204	2113743L09	CAP, 470pF
C205	Not_Placed	CAP, 2.7pF
C206	Not_Placed	CAP, 1000pF
C207	2113743L09	CAP, 470pF
C208	2113743L09	CAP, 470pF
C209	2113743L09	CAP, 470pF
C210	2113743L09	CAP, 470pF
C211	2113743E20	CAP, 0.1uF
C212	2113743F18	CAP, 2.2uF
C213	2113743L41	CAP, .01uF
C214	2113743L17	CAP, 1000pF
C215	2113743F18	CAP, 2.2uF
C216	2113743E20	CAP, 0.1uF
C217	2113743L17	CAP, 1000pF
C218	2113743F18	CAP, 2.2uF
C219	2113743E20	CAP, 0.1uF
C220	2113743N34	CAP, 22pF
C221	2113743L41	CAP, .01uF
C222	2113743L41	CAP, .01uF
C223	2113743L41	CAP, .01uF
C224	2113743L41	CAP, .01uF
C225	2311049A57	CAPP, 10uF
C226	2311049A57	CAPP, 10uF
C227	2113743L17	CAP, 1000pF
C228	2113743E20	CAP, 0.1uF
C230	2113743F18	CAP, 2.2uF
C231	2113743L17	CAP, 1000pF
C232	2113743E20	CAP, 0.1uF
C233	2311049A56	CAPP, 4.7uF
C241	2113743L19	CAP, 1200pF
C243	2113741M69	CAP, 0.1uF
C244	2113741F27	CAP, 1200pF
C245	2311049A08	CAPP, 1uF
C251	2113741F49	CAP, .01uF
C253	2109445U38	CAP, 16pF
C254	2109445U15	CAP, 3.3pF
C255	2109445U39	CAP, 18pF
C256	2109445U27	CAP, 10pF
C257	2109445U46	CAP, 36pF
C258	2113743L19	CAP, 1200pF
C263	2109445U43	CAP, 27pF
C264	2109445U19	CAP, 4.7pF
C265	2109445U37	CAP, 15pF
C266	2109445U27	CAP, 10pF
C267	2109445U46	CAP, 36pF
C268	2109445U13	CAP, 2.7pF
C269	2113743L21	CAP, 1500pF
C270	2113743L19	CAP, 1200pF
C271	2113743L41	CAP, .01uF
C272	2113743E20	CAP, 0.1uF
C273	2113743L41	CAP, .01uF
C274	2113743E20	CAP, 0.1uF
C275	2113743L19	CAP, 1200pF
C276	2113743N19	CAP, 5.1pF
C277	2113743L19	CAP, 1200pF
C281	2113743L19	CAP, 1200pF
C282	2113743N25	CAP, 9.1pF
C283	2113743L19	CAP, 1200pF
C284	2113743L19	CAP, 1200pF
C285	2113743E20	CAP, 0.1uF
C286	2113743N27	CAP, 11pF
C290	2113743N43	CAP, 51pF
C291	2113743N39	CAP, 36pF
C292	2113743L19	CAP, 1200pF
C301	2113743L07	CAP, 390pF
C302	2113743L07	CAP, 390pF
C303	2311049A97	CAPP, 33uF
C304	2113743L41	CAP, .01uF
C305	2113743N50	CAP, 100pF
C306	2113741F49	CAP, .01uF
C310	2113743L41	CAP, .01uF
C311	2113743E05	CAP, .018uF
C312	2311049A57	CAPP, 10uF
C313	2113743L41	CAP, .01uF
C314	2113743L19	CAP, 1200pF
C315	2113743L19	CAP, 1200pF
C316	2113743L19	CAP, 1200pF
C320	2113743E05	CAP, .018uF
C321	2311049A57	CAPP, 10uF
C322	2113743L41	CAP, .01uF
C323	2113743N54	CAP, 150pF
C331	2113743L41	CAP, .01uF
C333	2113743L41	CAP, .01uF
C334	2311049A57	CAPP, 10uF
C400	Not_Placed	CAP, .022uF
C401	2113743M24	CAP, 0.1uF
C402	2113743L17	CAP, 1000pF
C403	2113743N50	CAP, 100pF
C404	2113743L17	CAP, 1000pF
C405	2113743N50	CAP, 100pF
C406	2113743N50	CAP, 100pF
C407	2113743L17	CAP, 1000pF
C408	2113743L17	CAP, 1000pF
C409	2113743L17	CAP, 1000pF
C410	2311049A57	CAPP, 10uF

Circuit Ref	Motorola Part No.	Description
C411	2113743M24	CAP, 0.1uF
C412	2113743L17	CAP, 1000pF
C413	2113743M24	CAP, 0.1uF
C414	2113743M24	CAP, 0.1uF
C415	2113743L17	CAP, 1000pF
C416	2113743L17	CAP, 1000pF
C417	2113743L17	CAP, 1000pF
C418	2113743M24	CAP, 0.1uF
C419	2113743L17	CAP, 1000pF
C420	2113743L41	CAP, .01uF
C421	2113743L41	CAP, .01uF
C422	2113743L41	CAP, .01uF
C430	2113743M24	CAP, 0.1uF
C431	2113743L17	CAP, 1000pF
C432	2113743M24	CAP, 0.1uF
C433	2113743L17	CAP, 1000pF
C440	2113743L41	CAP, .01uF
C441	2113743L41	CAP, .01uF
C442	2113743L41	CAP, .01uF
C443	2113743L41	CAP, .01uF
C444	2113743L41	CAP, .01uF
C445	2113743L41	CAP, .01uF
C446	2113743L41	CAP, .01uF
C447	2113743M24	CAP, 0.1uF
C451	2113743M24	CAP, 0.1uF
C452	2113743E20	CAP, 0.1uF
C453	2311049A56	CAPP, 4.7uF
C454	2113743E20	CAP, 0.1uF
C455	2113743L48	CAP, .022uF
C456	2113743E20	CAP, 0.1uF
C457	2113743E20	CAP, 0.1uF
C458	2113743E20	CAP, 0.1uF
C459	2113743E20	CAP, 0.1uF
C460	2113743E20	CAP, 0.1uF
C461	2113743L17	CAP, 1000pF
C462	2113743E20	CAP, 0.1uF
C463	2113743E20	CAP, 0.1uF
C464	2113743E20	CAP, 0.1uF
C465	2113743L17	CAP, 1000pF
C466	Not_Placed	CAP, 470pF
C467	2113743L19	CAP, 1200pF
C470	2113743E20	CAP, 0.1uF
C471	2113743F18	CAP, 2.2uF
C472	2113743E20	CAP, 0.1uF
C473	2113743N54	CAP, 150pF
C474	2113743N54	CAP, 150pF
C475	2113743L48	CAP, .022uF
C476	2113743L48	CAP, .022uF
C477	2113743M24	CAP, 0.1uF
C478	2113743N54	CAP, 150pF
C479	2113743N54	CAP, 150pF
C480	2113743E20	CAP, 0.1uF
C481	Not_Placed	CAP, .01uF
C482	Not_Placed	CAP, .01uF
C483	2113928H02	CAP, 0.22uF
C484	Not_Placed	CAP, .033uF
C488	2113743L09	CAP, 470pF
C489	2113743L09	CAP, 470pF
C490	2113743L09	CAP, 470pF
C492	2113928J08	CAP, 10uF
C493	2113743L17	CAP, 1000pF
C494	2113743F18	CAP, 2.2uF
C495	2113743F16	CAP, 1uF
C496	2113743F16	CAP, 1uF
C497	2113743E20	CAP, 0.1uF
C498	2113743F16	CAP, 1uF
C499	2113743N40	CAP, 39pF
C500	2113743L17	CAP, 1000pF
C501	2113743F16	CAP, 1uF
C503	2113743L17	CAP, 1000pF
C504	2113743L17	CAP, 1000pF
C505	2113743L17	CAP, 1000pF
C506	2113743L17	CAP, 1000pF
C507	2113743L17	CAP, 1000pF
C511	2113740F59	CAP, 220pF
C512	2113743N22	CAP, 6.8pF
C513	2113740F59	CAP, 220pF
C514	2113743N31	CAP, 16pF
C518	2113743E20	CAP, 0.1uF
C519	2113743F16	CAP, 1uF
CR1	4813825A19	MMBD352
CR41	4802246J04	HSMS2829
CR51	4813825A19	MMBD352
D51	4802245J97	DAN235ETL
D52	4802245J97	DAN235ETL
D120	4880973Z02	MA4PH261
D121	4880973Z02	MA4PH261
D201	4862824C03	1SV232
D220	4802233J09	IMN10
D221	4802233J09	IMN10
D251	4805649Q13	1SV228
D261	4805649Q13	1SV228
D262	4862824C01	1SV229
D301	4813833A19	MBRM120ET3
D414	4805129M41	MMBD501
D424	4809924D18	RB520S-30
D440	4805729G49	BRPY1204W
D470	4809924D18	RB520S-30
D471	4809924D18	RB520S-30
D491	Not_Placed	MMBD501
E451	2480640Z01	BK1005HM471
E452	2480640Z01	BK1005HM471
E453	2480640Z01	BK1005HM471
E500	2480640Z01	BK1005HM471
F301	6580542Z01	FUSE
FL51	9180022M11	MXF45
FL52	9180468V04	FLTR
FL53	9180469V05	CFWC455E
FL54	9180469V03	CFWC455G
J140	0986428Z01	connector, external antenna
J301	0986565Z01	battery contact assembly
J460	Not_Placed	CONN_J
J470	0985818A01	connector, 2-pin, internal mic
J471	0980683Z03	connector, 2.5 / 3.5 mm, accessories
J491	2809926G01	connector, 2-pin, internal speaker
L1	2413923C09	IDCTR, 68nH
L2	2413923C09	IDCTR, 68nH
L3	2413923C09	IDCTR, 68nH
L4	2413923C09	IDCTR, 68nH
L21	Not_Placed	IDCTR, 39nH
L22	2413926N24	IDCTR, 100nH
L31	2413923C09	IDCTR, 68nH
L32	2413923C09	IDCTR, 68nH
L33	2413923C09	IDCTR, 68nH
L40	2413923C09	IDCTR, 68nH
L41	2413923C09	IDCTR, 68nH
L51	2413926N26	IDCTR, 150nH
L52	2462587V44	IDCTR, 680nH
L53	2113743N52	CAP, 120pF
L54	2413923A25	IDCTR, 1.2uH
L81	2413923A19	IDCTR, 1uH
L100	2413926K32	IDCTR, 560nH
L101	2413926K32	IDCTR, 560nH
L102	2409377M17	IDCTR, 100nH
L103	2409377M31	IDCTR, 30nH
L110	2413926K32	IDCTR, 560nH
L120	2413926K32	IDCTR, 560nH
L121	2462587N49	IDCTR, 47nH
L130	2479990N01	IDCTR, 43.67nH
L131	2479990N01	IDCTR, 43.67nH
L132	2479990N01	IDCTR, 43.67nH
L140	2479990M01	IDCTR, 30.54nH
L211	2413926K32	IDCTR, 560nH
L251	2413926K32	IDCTR, 560nH
L252	2413926K32	IDCTR, 560nH
L253	2409377M17	IDCTR, 100nH
L254	2413923C05	IDCTR, 33nH
L255	2413926K29	IDCTR, 330nH
L262	2413926K32	IDCTR, 560nH
L263	2409377M17	IDCTR, 100nH
L264	2413923C07	IDCTR, 47nH
L265	2413926K29	IDCTR, 330nH
L270	2413926K32	IDCTR, 560nH
L271	Not_Placed	IDCTR, 560nH
L276	2413926N24	IDCTR, 100nH
L281	2413926N22	IDCTR, 68nH
L282	2413926N20	IDCTR, 47nH
L283	Not_Placed	IDCTR, 270nH
L291	2413926N17	IDCTR, 27nH
L292	2413926N22	IDCTR, 68nH
L471	2413926K30	IDCTR, 390nH
M140	0286427Z01	ANTENNA_NUT
Q21	4802245J95	BFS540
Q22	4805723X02	UMT1
Q51	4802197J95	PBR941
Q70	4880214G02	MMBT3904
Q100	4802245J95	BFS540
Q150	4880214G02	MMBT3904
Q170	4809939C34	EMB10
Q171	4880214G02	MMBT3904
Q280	4802245J95	BFS540
Q311	4809579E18	TP0101T
Q312	4809579E18	TP0101T
Q313	4802245J54	UMG5
Q402	4880048M01	DTC144EKA
Q403	4813824A17	MMBT3906
Q410	4802245J54	UMG5
Q440	5180159R01	IMX1
Q470	4805723X02	UMT1
Q471	4802245J54	UMG5
Q472	4805723X02	UMT1
Q481	Not_Placed	MMBT3906
Q482	Not_Placed	MMBT3904
Q490	4802245J54	UMG5
Q493	4809579E18	TP0101T
Q494	4802245J54	UMG5
Q520	5180159R01	IMX1
R20	0662057U97	RES, 6.8K
R21	0662057M50	RES, 100
R22	0662057M94	RES, 6.8K
R23	0662057V11	RES, 22K
R24	0662057M71	RES, 750
R25	0662057M92	RES, 5.6K
R26	0662057M01	RES, 0
R40	0662057M74	RES, 1K
R51	0662057M43	RES, 51
R52	0662057N01	RES, 12K
R53	0662057N11	RES, 33K
R54	0662057M91	RES, 5.1K
R55	0662057M62	RES, 330
R57	0662057M90	RES, 4.7K
R60	0662057M83	RES, 2.4K

Circuit Ref	Motorola Part No.	Description
R61	0662057N23	RES, 100K
R62	0662057M86	RES, 3.3K
R63	0662057N13	RES, 39K
R64	0662057N06	RES, 20K
R65	0662057N13	RES, 39K
R66	0662057N06	RES, 20K
R67	0662057N06	RES, 20K
R72	0662057M64	RES, 390
R73	0662057M80	RES, 1.8K
R74	0662057M76	RES, 1.2K
R75	0662057N01	RES, 12K
R76	0662057V04	RES, 12K
R77	0662057U99	RES, 8.2K
R78	0662057M70	RES, 680
R80	0662057M91	RES, 5.1K
R81	0662057M74	RES, 1K
R82	Not_Placed	RES, 0
R90	0662057M43	RES, 51
R91	0662057M79	RES, 1.6K
R100	0662057M61	RES, 300
R101	0662057M32	RES, 18
R102	0662057M61	RES, 300
R103	0662057M86	RES, 3.3K
R104	0662057A18	RES, 51
R105	0662057M76	RES, 1.2K
R106	0662057M90	RES, 4.7K
R107	0662057M54	RES, 150
R110	0662057M63	RES, 360
R111	Not_Placed	RES, 2.7K
R120	0662057C55	RES, 150
R121	0662057C55	RES, 150
R150	0680539Z01	RES, 0.1
R151	0662057A09	RES, 22
R152	0662057V27	RES, 100K
R153	0662057V27	RES, 100K
R154	0662057V27	RES, 100K
R155	0662057V27	RES, 100K
R156	0662057M62	RES, 330
R157	0662057M92	RES, 5.6K
R158	0662057M78	RES, 1.5K
R162	0662057M98	RES, 10K
R171	0662057M94	RES, 6.8K
R202	0662057N27	RES, 150K
R205	0662057M50	RES, 100
R206	Not_Placed	RES, 100
R212	0662057C01	RES, 0
R220	0662057M54	RES, 150
R221	0662057M54	RES, 150
R223	0662057M50	RES, 100
R227	0662057N27	RES, 150K
R230	0662057N30	RES, 200K
R243	0662057M81	RES, 2K
R244	0662057M43	RES, 51
R245	0662057M78	RES, 1.5K
R246	0662057N23	RES, 100K
R247	0662057N33	RES, 270K
R248	0662057M43	RES, 51
R253	0662057M42	RES, 47
R254	0662057M58	RES, 220
R255	0662057U91	RES, 3.9K
R261	0662057N16	RES, 51K
R262	0662057M94	RES, 6.8K
R263	0662057M37	RES, 30
R264	0662057M58	RES, 220
R270	0662057M32	RES, 18
R271	0662057M96	RES, 8.2K
R272	0662057M97	RES, 9.1K
R273	0662057M61	RES, 300
R274	0662057M38	RES, 33
R275	0662057M01	RES, 0
R276	0662057M74	RES, 1K
R280	0662057M94	RES, 6.8K
R281	0662057M97	RES, 9.1K
R282	0662057M71	RES, 750
R283	0662057M56	RES, 180
R284	0662057M62	RES, 330
R286	0662057M01	RES, 0
R310	0662057N23	RES, 100K
R311	0662057N23	RES, 100K
R312	0662057N06	RES, 20K
R313	0662057M91	RES, 5.1K
R320	0662057V43	RES, 330K
R321	0662057V35	RES, 200K
R322	0662057N23	RES, 100K
R400	Not_Placed	RES, 100K
R410	0662057M98	RES, 10K
R411	0662057M72	RES, 820
R412	0662057N23	RES, 100K
R413	0662057N23	RES, 100K
R414	0662057N11	RES, 33K
R415	0662057N11	RES, 33K
R416	0662057N06	RES, 20K
R417	0662057M98	RES, 10K
R418	0662057N23	RES, 100K
R419	0662057M90	RES, 4.7K
R420	0662057V35	RES, 200K
R421	0662057V27	RES, 100K
R422	0662057N23	RES, 100K
R423	0662057N23	RES, 100K
R424	0662057V35	RES, 200K
R425	0662057V27	RES, 100K
R430	0662057N23	RES, 100K
R431	Not_Placed	RES, 100K
R432	0662057M01	RES, 0
R433	0662057N23	RES, 100K
R434	Not_Placed	RES, 100K
R440	0662057M90	RES, 4.7K
R441	0662057M90	RES, 4.7K
R442	0662057A33	RES, 220
R443	0662057A27	RES, 120
R445	0662057M90	RES, 4.7K
R446	0662057M98	RES, 10K
R451	0662057N15	RES, 47K
R460	0662057N08	RES, 24K
R462	0662057N08	RES, 24K
R463	0662057N08	RES, 24K
R464	0662057N10	RES, 30K
R469	0662057M26	RES, 10
R470	0662057M82	RES, 2.2K
R471	0662057M82	RES, 2.2K
R472	0662057M70	RES, 680
R473	0662057M70	RES, 680
R474	0662057A37	RES, 330
R475	0662057N29	RES, 180K
R476	0662057N23	RES, 100K
R477	0662057M82	RES, 2.2K
R478	0662057M82	RES, 2.2K
R479	0662057N23	RES, 100K
R480	0662057B47	RES, 0
R481	Not_Placed	RES, 100K
R482	Not_Placed	RES, 330K
R483	Not_Placed	RES, 150K
R484	Not_Placed	RES, 2.2K
R485	Not_Placed	RES, 100K
R486	Not_Placed	RES, 100K
R487	0662057M01	RES, 0
R488	0662057N35	RES, 330K
R489	Not_Placed	RES, 91K
R490	Not_Placed	RES, 2.2K
R491	0662057M01	RES, 0
R492	0662057N08	RES, 24K
R493	0662057N35	RES, 330K
R494	0662057V43	RES, 330K
R495	0662057M92	RES, 5.6K
R496	Not_Placed	RES, 10K
R497	Not_Placed	RES, 1MEG
R498	Not_Placed	RES, 47K
R499	Not_Placed	RES, 270K
R501	0662057M50	RES, 100
R502	0662057M50	RES, 100
R503	0662057M50	RES, 100
R504	0662057M50	RES, 100
R505	0662057M50	RES, 100
R506	0662057M50	RES, 100
R507	0662057M50	RES, 100
R508	0662057N23	RES, 100K
R509	0662057N23	RES, 100K
R510	0662057N35	RES, 330K
R511	0662057N23	RES, 100K
R512	0662057N27	RES, 150K
R513	Not_Placed	RES, 100K
R514	0662057N23	RES, 100K
R515	Not_Placed	RES, 0
R516	Not_Placed	RES, 0
R517	0662057M01	RES, 0
R518	0662057N31	RES, 220K
R519	0662057N23	RES, 100K
R520	0662057N23	RES, 100K
R521	Not_Placed	RES, 100K
R522	0662057N23	RES, 100K
R523	0662057M98	RES, 10K
R524	0662057M98	RES, 10K
S440	4080710Z22 or 4080710Z13	switch, rotary, 16-Ch. select switch, rotary, 4-Ch. select
S441	4070354A01	switch, pushbutton PTT
S442	4070354A01	switch, pushbutton, side option (lower)
S443	4070354A01	switch, pushbutton, side option (upper)
S444	1880619Z02	switch, rotary on-off, with 10K volume control
SH1	2686421Z01	shield, comp side, RF front end
SH40	2686419Z01	shield, solder side, first mixer
SH50	2686423Z01	shield, solder side, IFIC and 2nd LO cyrstal
SH52	2686424Z01	shield, solder side, high IF crystal filter
SH100	2686418Z01	shield, solder side, transmitter
SH200	2686424Z01	shield, solder side, synthe-sizer charge pump
SH201	2686423Z01	shield, comp side, synthesizer
SH250	2686425Z01	shield, comp side, VCO tank circuits
SH251	2686425Z01	shield, solder side, VCOBIC
SH253	2686422Z01	shield, comp side, VCO RX injection buffer
SH400	2686420Z01	shield, solder side, micropro-cessor
SH401	2686420Z01	shield, comp side, memory
T41	2580541Z02	transformer, balun
T42	2580541Z02	transformer, balun
U51	5186144B01	SA616

Circuit Ref	Motorola Part No.	Description
U52	5109522E10	TC7W04F
U110	0186438Z01	RA07M1317M_VHF
U150	5113818A01	LM2904
U151	2484657R01	57R01
U201*	5185963A27	63A27
U251	5105750U54	50U54
U310	5102478J01	TK71750S
U320	5185963A55	LP2986
U330	5102479J01	TK71730S
U401*	5102226J56	MC68HC11FL0
U402*	5102463J64	X25128-2.7
U403	Not_Placed	SRM2B256
U404*	5102480J01	AT49LV001N_70VI
U451	5185130C53	30C53
U480	Not_Placed	LM2904
U490	5108858K99	TDA8541
U510	5113818A01	LM2904
U511	4802245J54	UMG5
VR110	4813830A82	MM3Z4V3T1
VR301	4813830A33	MMBZ5250B
VR302	4813830A33	MMBZ5250B
VR471	4813830A18	MMBZ5235B
VR472	4813830A09	MMBZ5226B
VR473	4813830A33	MMBZ5250B
VR474	4813830A33	MMBZ5250B
VR475	4880140L20	MMBZ5245B
Y51	4802245J84	45J84
Y70	9186145B02	45B02
Y201*	4880114R06	14R06
Y202	Not_Placed	45J68

* Motorola Depot Servicing only

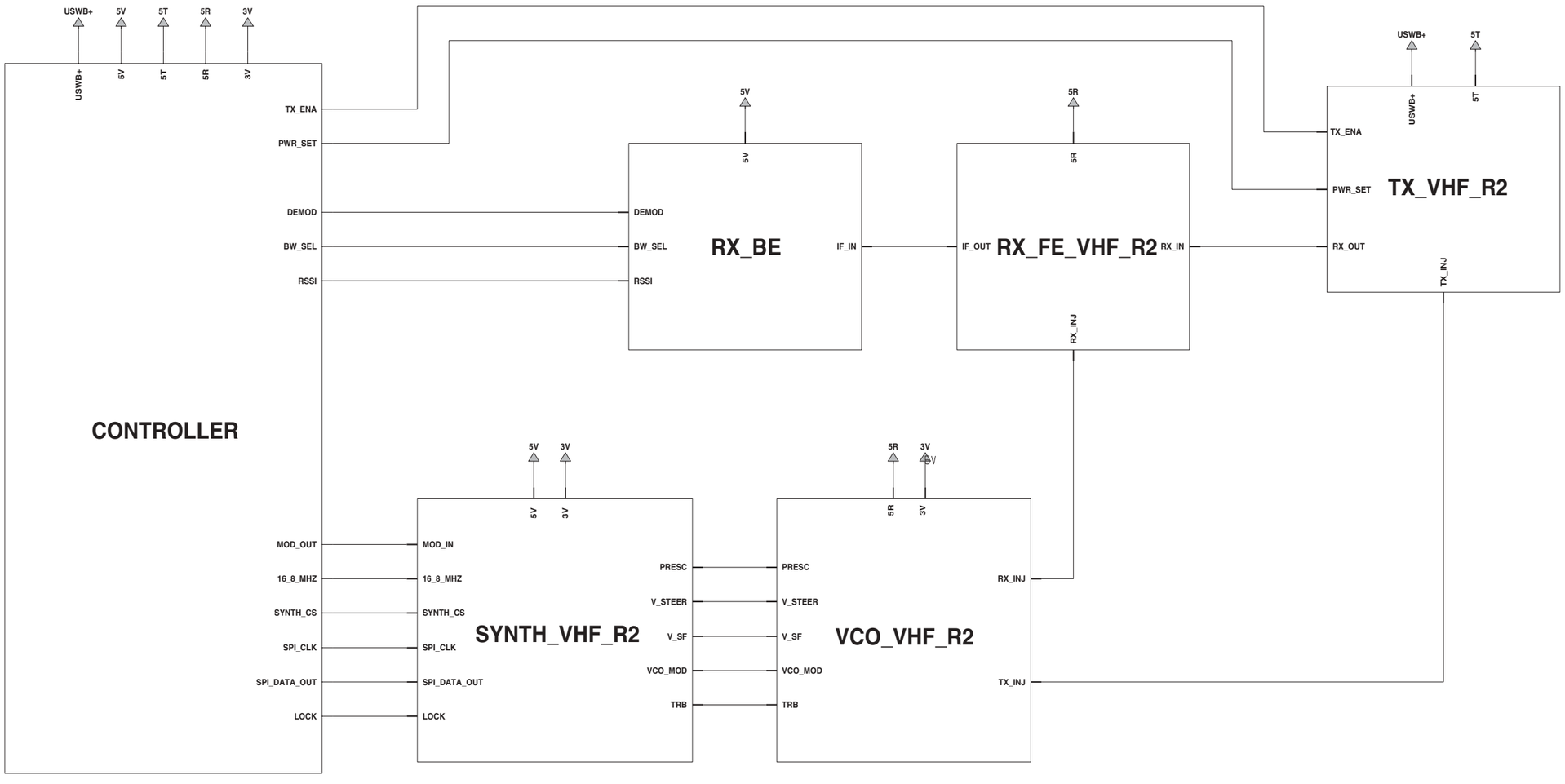


Figure 7-52. VHF (146-174 MHz) Radio Circuit Block Interconnect Diagram (8486769Z04-C)

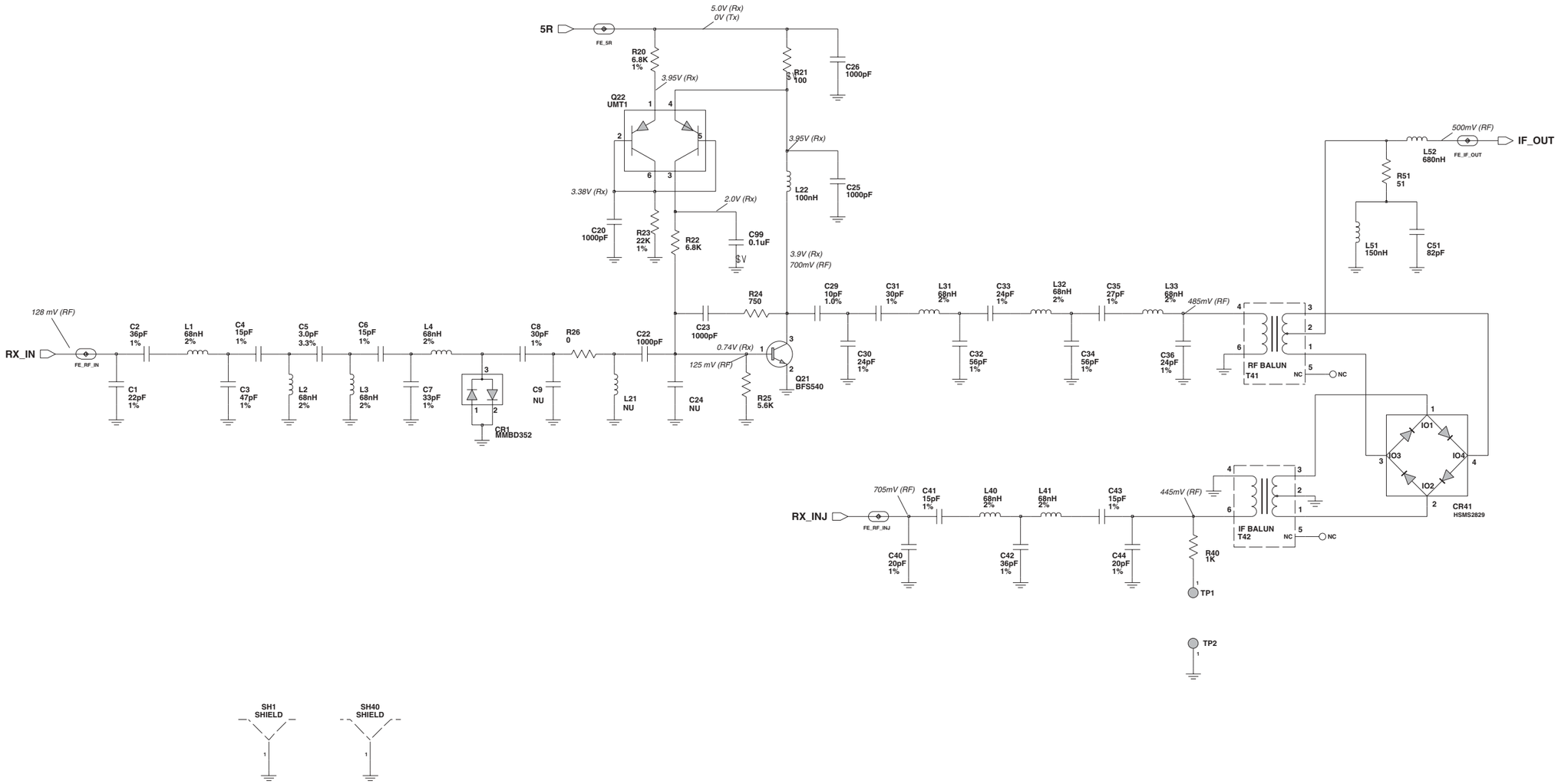


Figure 7-53. VHF (146-174 MHz) Receiver Front End Schematic Diagram (8486769Z04-C)

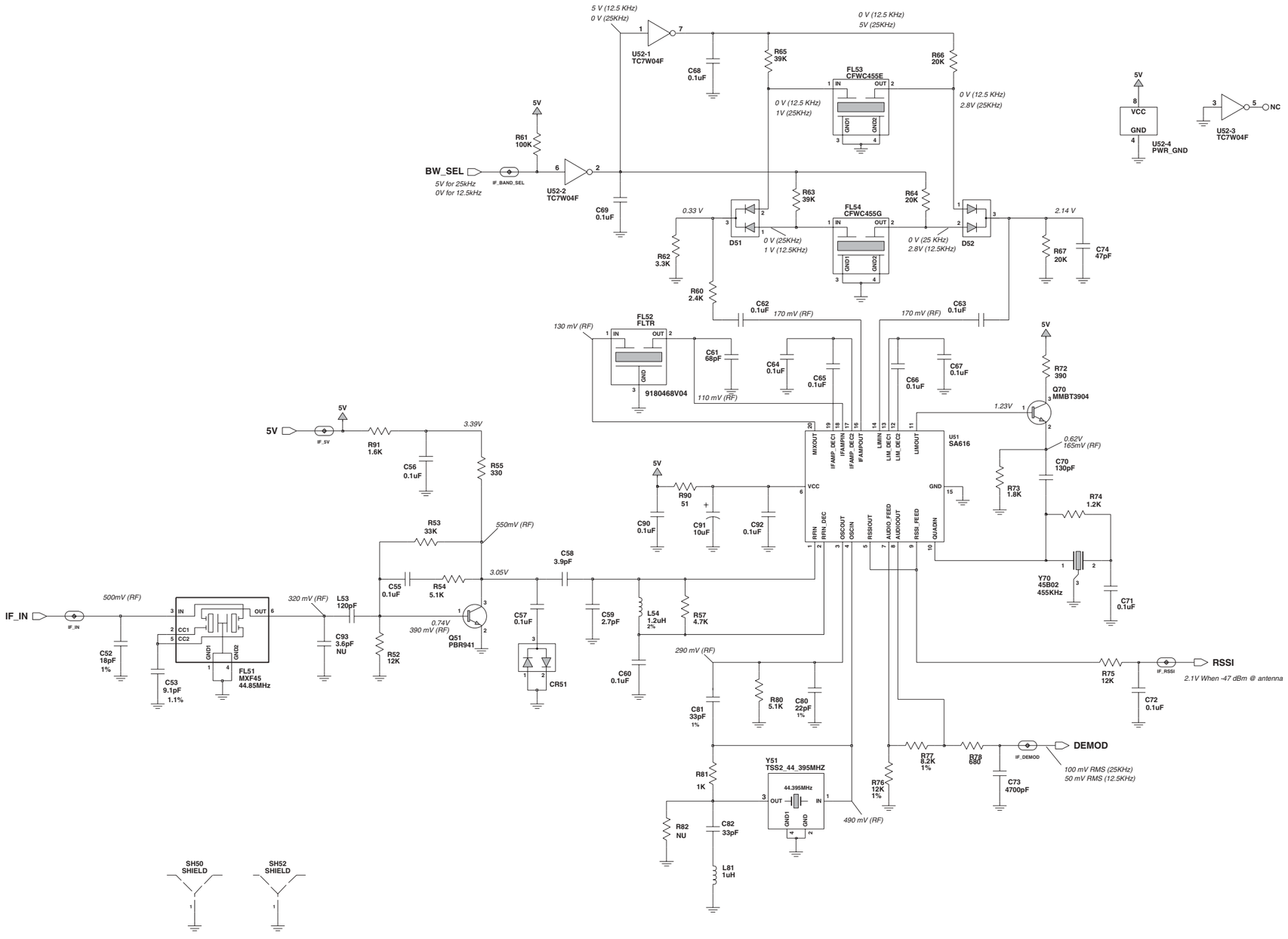
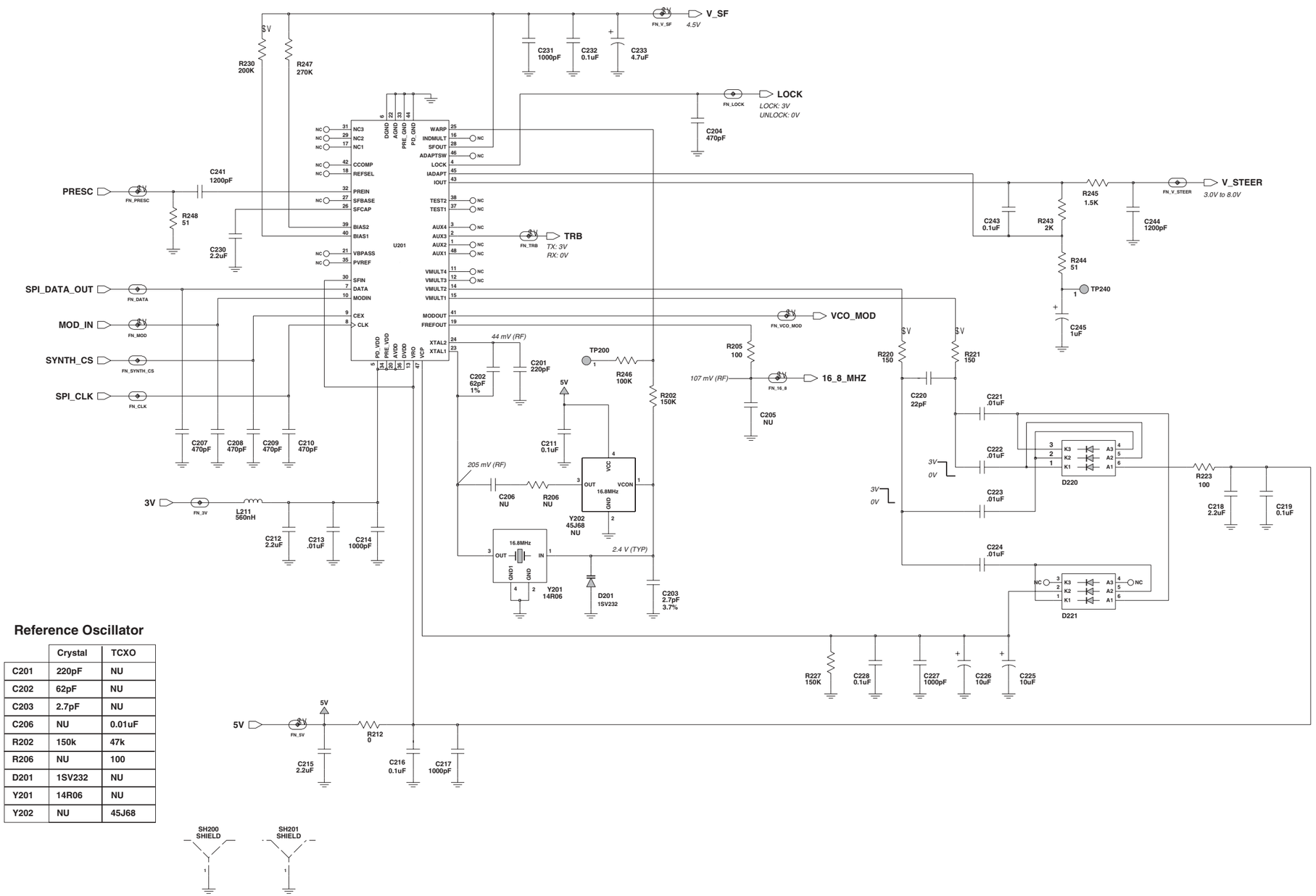


Figure 7-54. VHF (146-174 MHz) Receiver Back End Schematic Diagram (8486769Z04-C)



Reference Oscillator

	Crystal	TCXO
C201	220pF	NU
C202	62pF	NU
C203	2.7pF	NU
C206	NU	0.01uF
R202	150k	47k
R206	NU	100
D201	1SV232	NU
Y201	14R06	NU
Y202	NU	45J68

Figure 7-55. VHF (146-174 MHz) Synthesizer Schematic Diagram (8486769Z04-C)

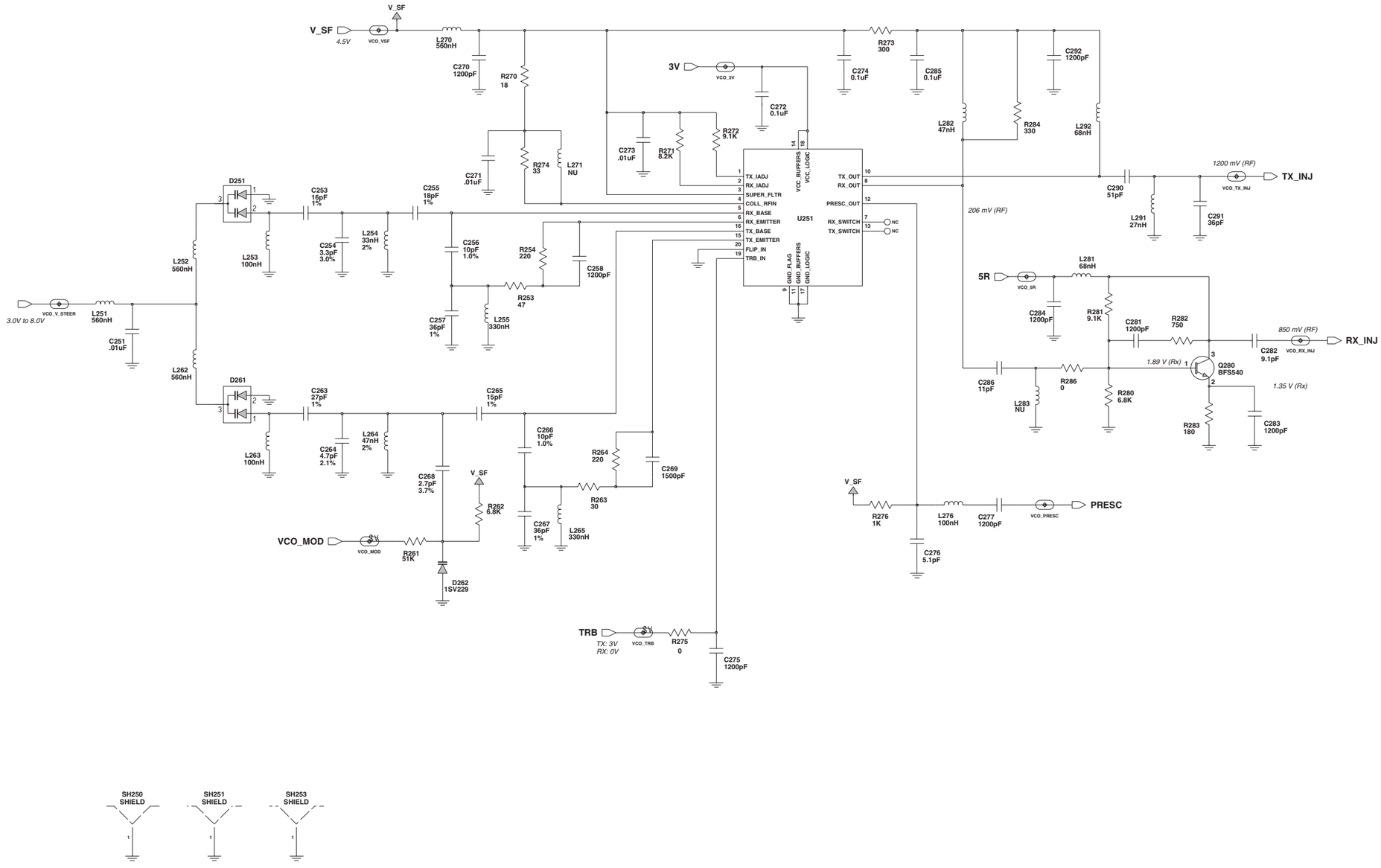


Figure 7-56. VHF (146-174 MHz) Voltage Controlled Oscillator Schematic Diagram (8486769Z04-C)

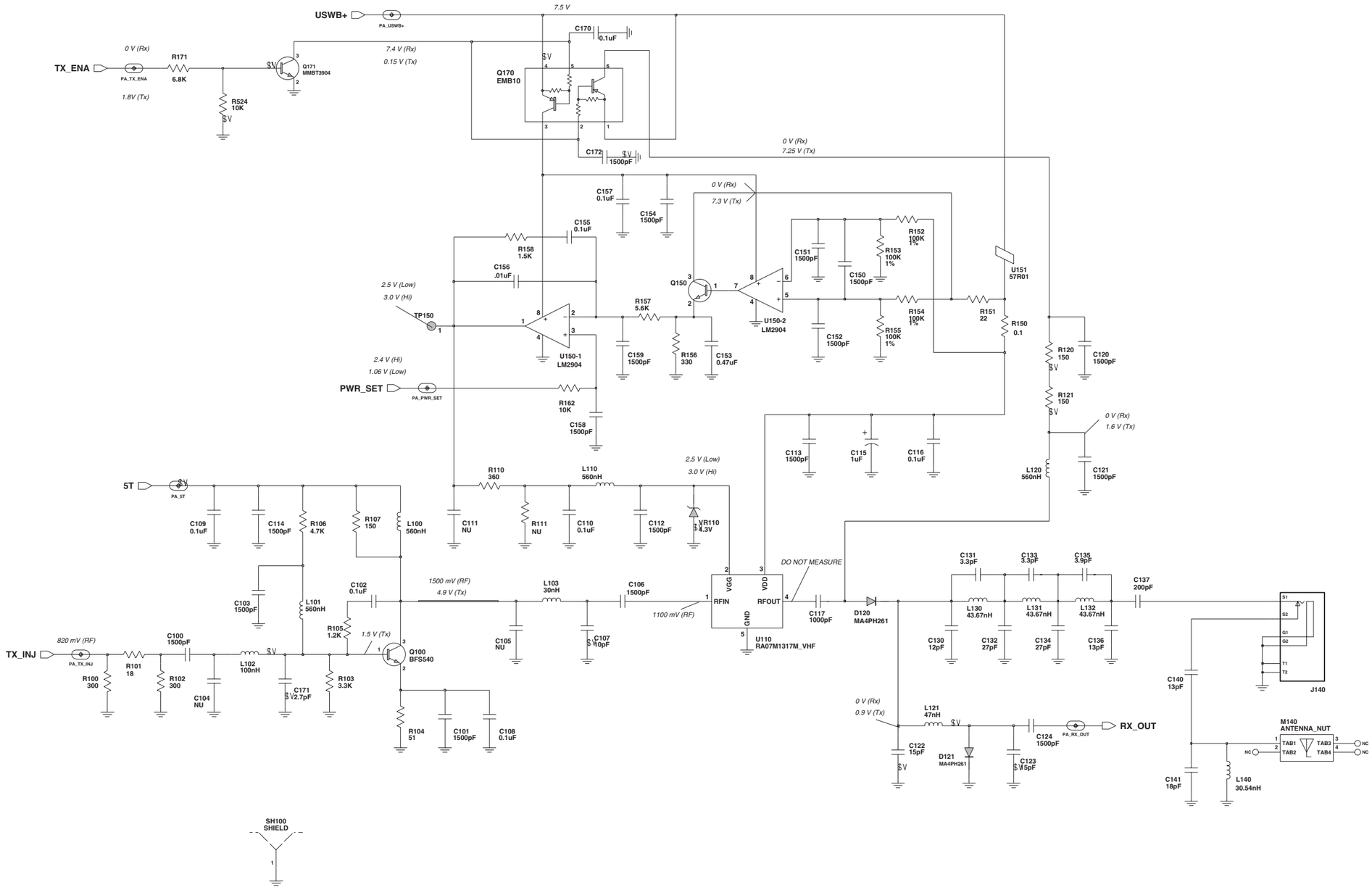


Figure 7-57. VHF (146-174 MHz) Transmitter and Power Control Schematic Diagram (8486769Z04-C)

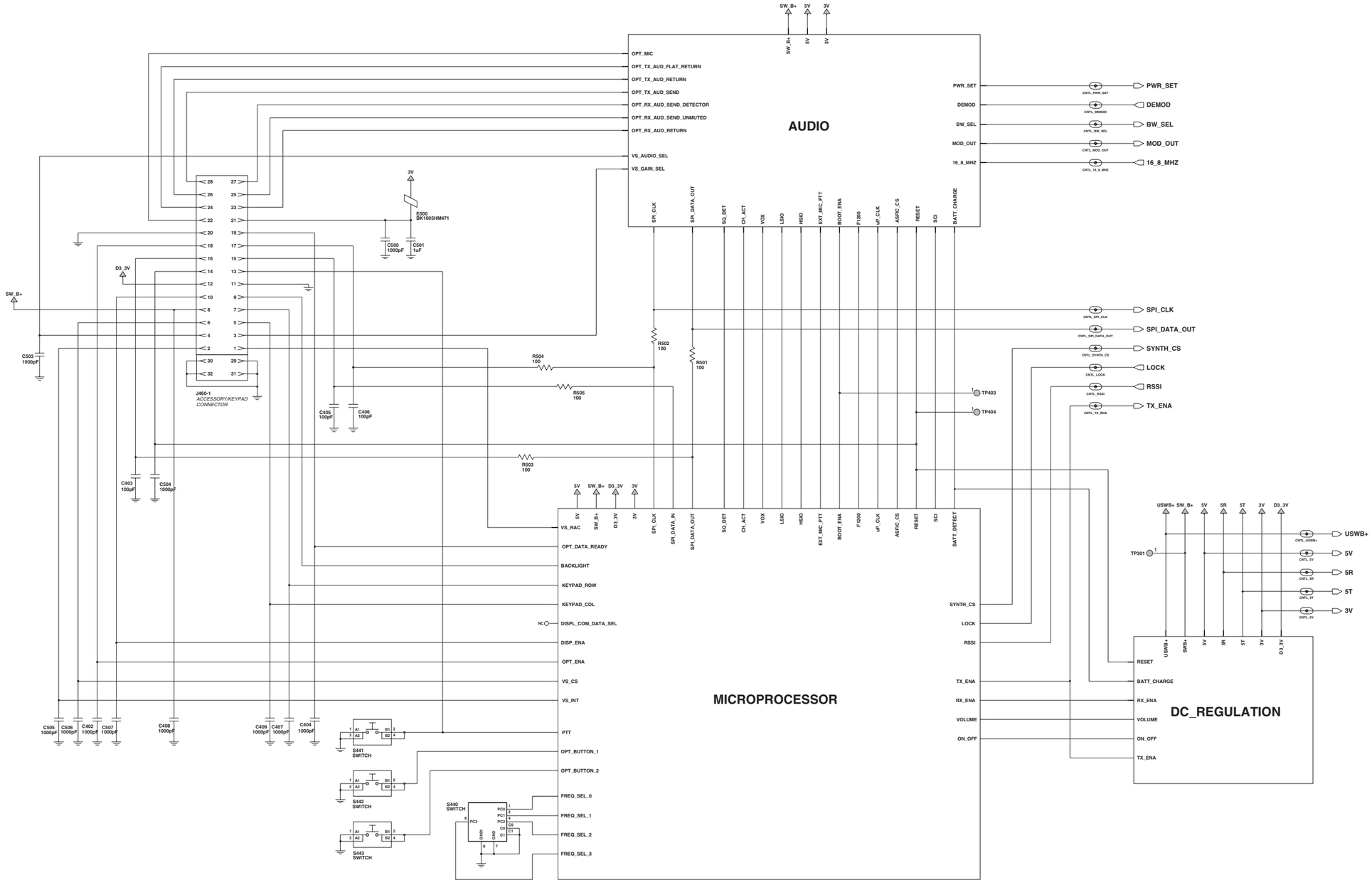


Figure 7-58. VHF (146-174 MHz) Controller Interconnect Schematic Diagram (8486769Z04-C)

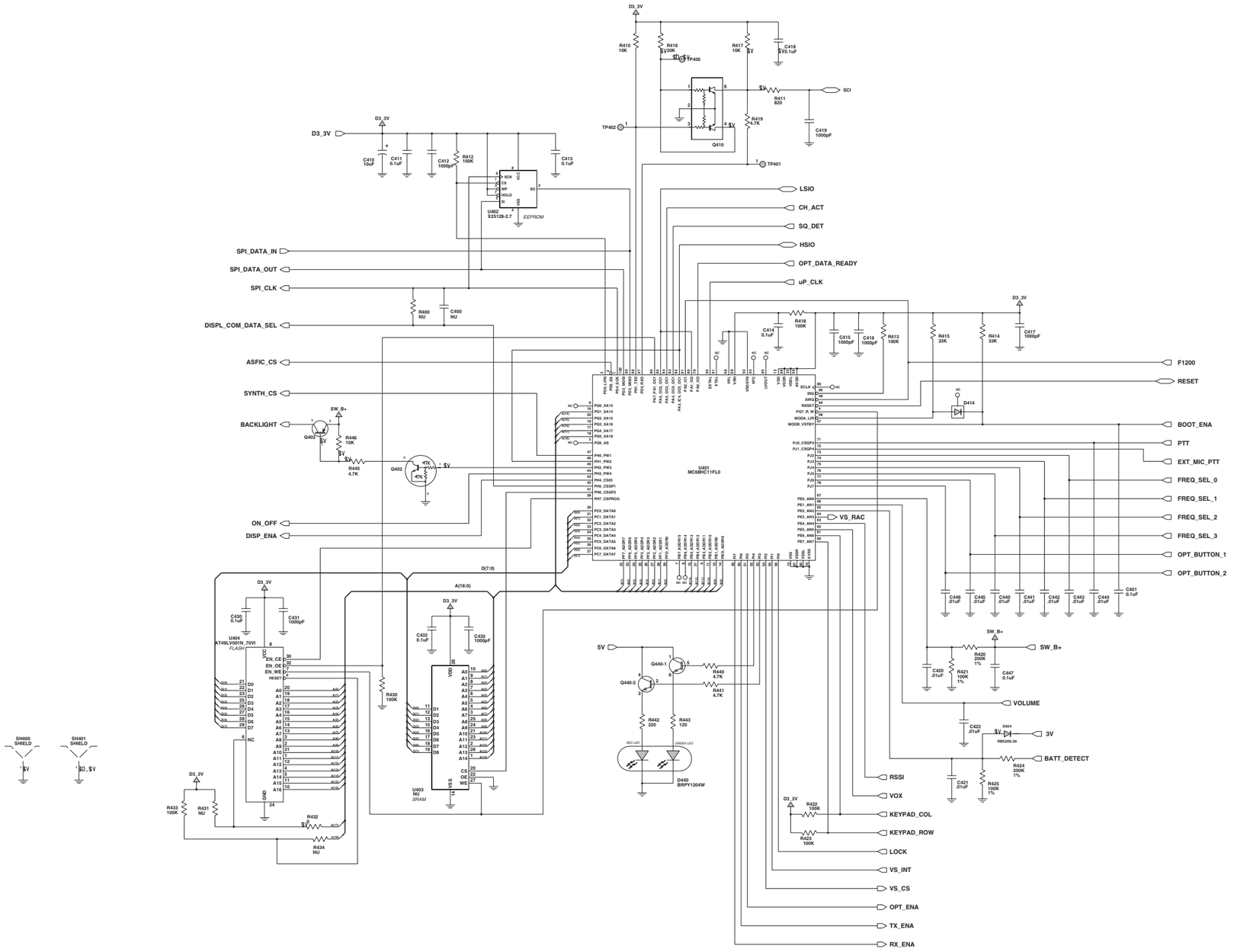


Figure 7-59. VHF (146-174 MHz) Microprocessor Circuitry Schematic Diagram (8486769Z04-C)

	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

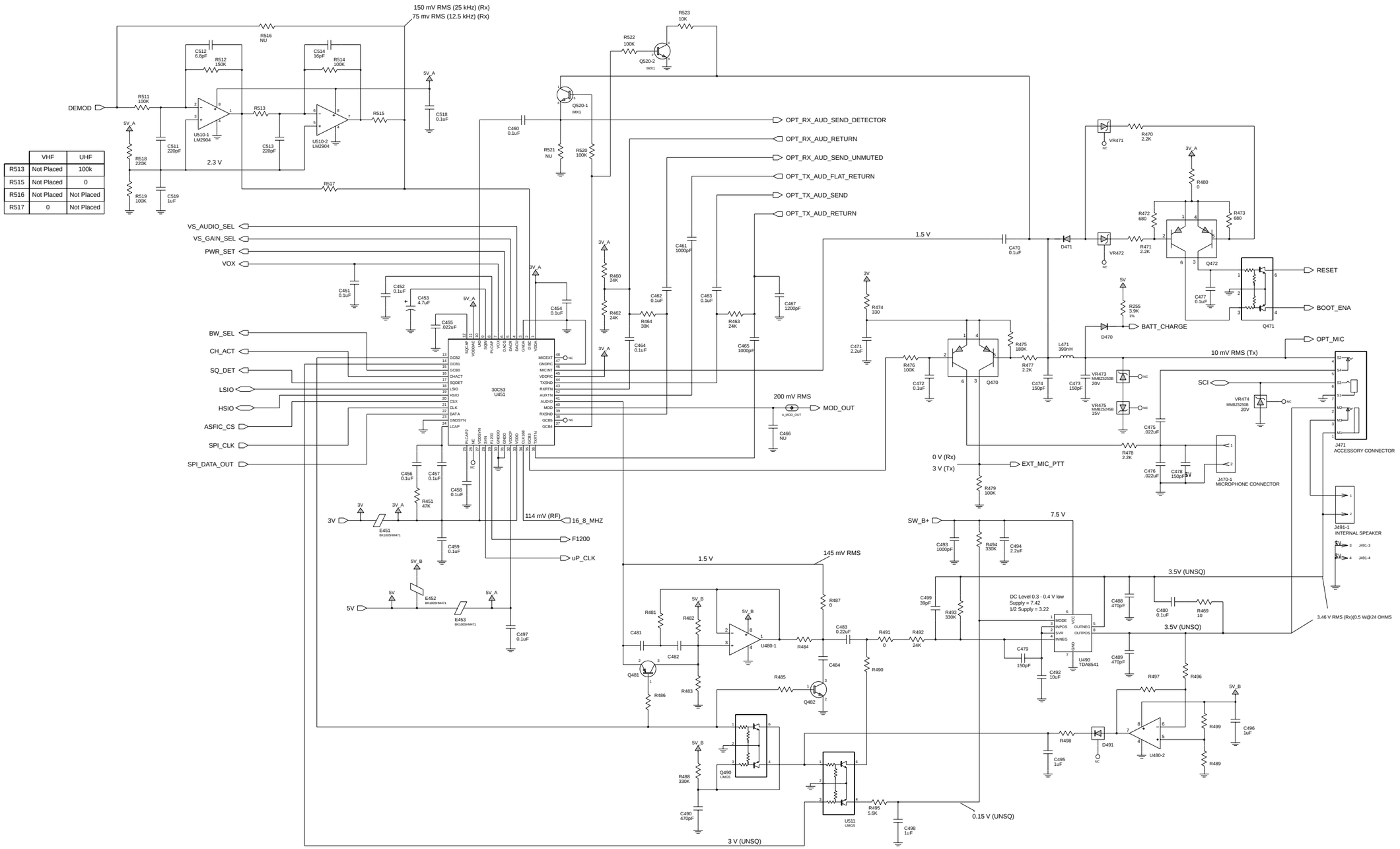


Figure 7-60. VHF (146-174 MHz) Audio Circuitry Schematic Diagram (8486769Z04-C)

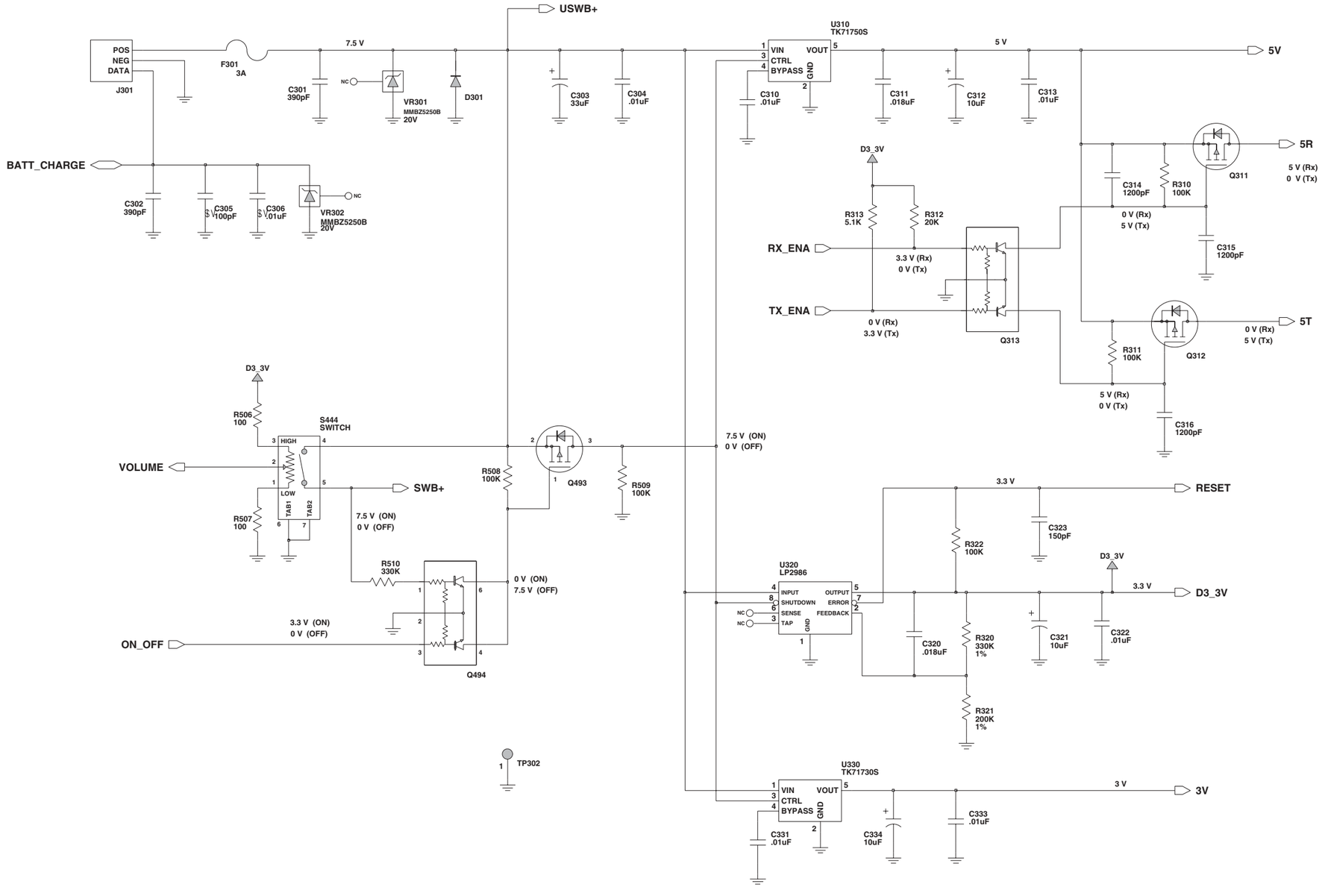
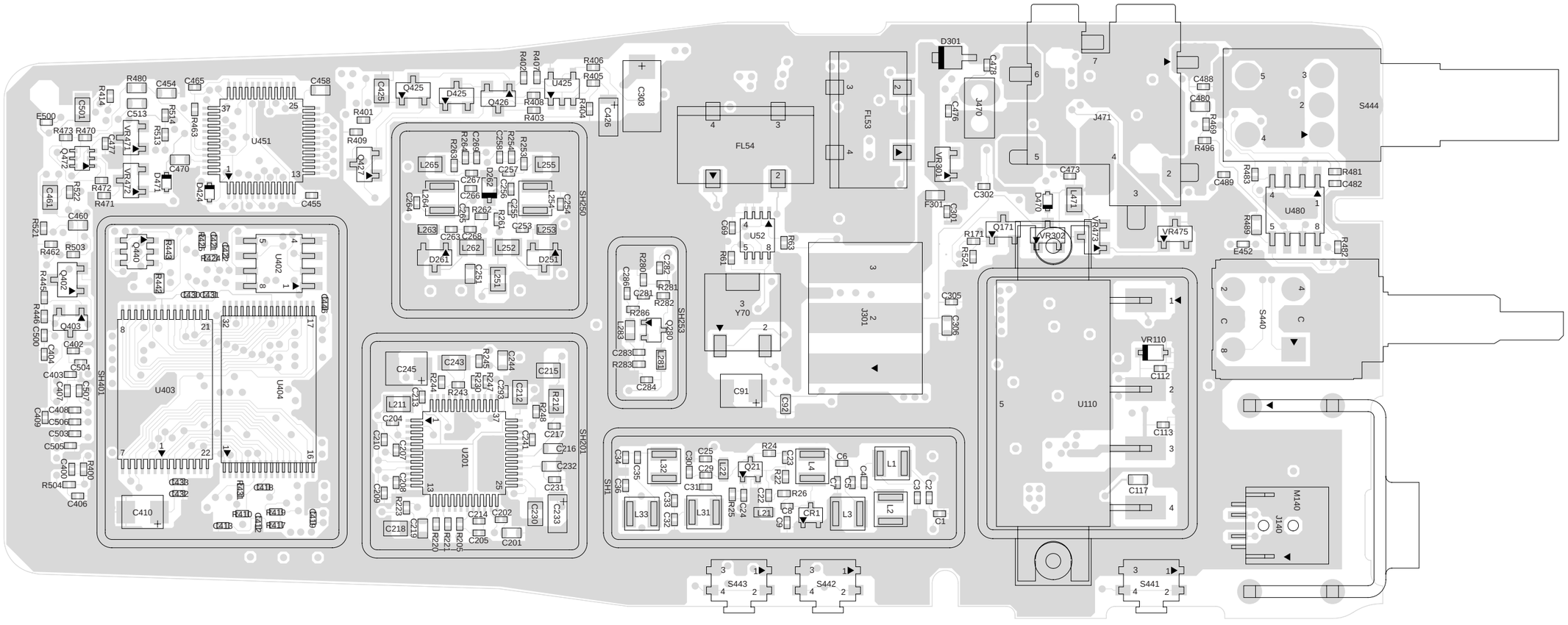


Figure 7-61. VHF (146-174 MHz) DC Regulation Schematic Diagram (8486769Z04-C)



ZMY30000-O

Figure 7-62. VHF (146-174 MHz) Board Component Side View (8486769Z04-C)

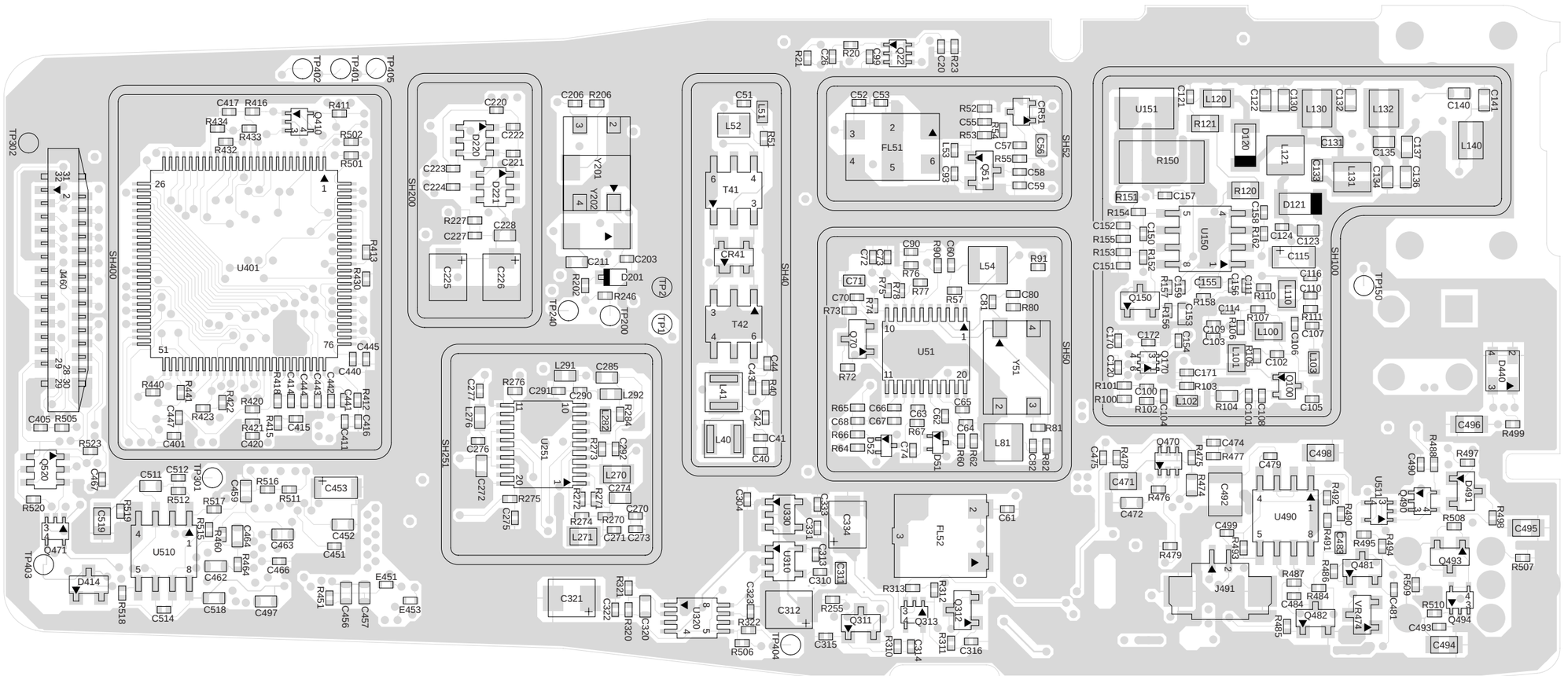


Figure 7-63. VHF (146-174 MHz) Board Solder Side View (8486769Z04-C)

VHF (146-174 MHz) Radio Parts List (8486769Z04-C)

Circuit Ref	Motorola Part No.	Description
C1	2115153H41	CAP, 22pF
C2	2115153H46	CAP, 36pF
C3	2115153H49	CAP, 47pF
C4	2115153H37	CAP, 15pF
C5	2115153H14	CAP, 3pF
C6	2115153H37	CAP, 15pF
C7	2115153H45	CAP, 33pF
C8	2115153H44	CAP, 30pF
C9	Not_Placed	-
C20	2113945A09	CAP, 1000pF
C22	2113945A09	CAP, 1000pF
C23	2113945A09	CAP, 1000pF
C24	Not_Placed	-
C25	2113945A09	CAP, 1000pF
C26	2113945A09	CAP, 1000pF
C29	2115153H27	CAP, 10pF
C30	2115153H42	CAP, 24pF
C31	2115153H44	CAP, 30pF
C32	2115153H51	CAP, 68pF
C33	2115153H42	CAP, 24pF
C34	2115153H51	CAP, 68pF
C35	2115153H43	CAP, 27pF
C36	2115153H42	CAP, 24pF
C40	2115153H40	CAP, 20pF
C41	2115153H37	CAP, 15pF
C42	2115153H46	CAP, 36pF
C43	2115153H37	CAP, 15pF
C44	2115153H40	CAP, 20pF
C51	2113944A38	CAP, 82pF
C52	2115153H39	CAP, 18pF
C53	2115153H26	CAP, 9.1pF
C55	2113946K02	CAP, 100000pF
C56	2113945C31	CAP, 0.10uF
C57	2113946K02	CAP, 100000pF
C58	2113944A15	CAP, 25pF
C59	2113944A11	CAP, 2.7pF
C60	2113946K02	CAP, 100000pF
C61	2113944A36	CAP, 68pF
C62	2113946K02	CAP, 100000pF
C63	2113946K02	CAP, 100000pF
C64	2113946K02	CAP, 100000pF
C65	2113946K02	CAP, 100000pF
C66	2113946K02	CAP, 100000pF
C67	2113946K02	CAP, 100000pF
C68	2113946K02	CAP, 100000pF
C69	2113946K02	CAP, 100000pF
C70	2113944A87	CAP, 130pF
C71	2113945C31	CAP, 0.10uF
C72	2113946K02	CAP, 100000pF
C73	2113945A13	CAP, 4700pF
C74	2113944A33	CAP, 47pF
C80	2115153H41	CAP, 22pF
C81	2115153H45	CAP, 33pF
C82	2115153H45	CAP, 33pF
C90	2113946K02	CAP, 100000pF
C91	2313960D07	CAP, 10uF
C92	2113945C31	CAP, 0.10uF
C93	Not_Placed	-
C99	2113946K02	CAP, 100000pF
C100	2113945A10	CAP, 1500pF
C101	2113945A10	CAP, 1500pF
C102	2113946K02	CAP, 100000pF
C103	2113945A10	CAP, 1500pF
C104	Not_Placed	-
C105	Not_Placed	-
C106	2113945A10	CAP, 1500pF
C107	2113944A25	CAP, 10pF
C108	2113946K02	CAP, 100000pF
C109	2113946K02	CAP, 100000pF
C110	2113946K02	CAP, 100000pF
C111	Not_Placed	-
C112	2113945A10	CAP, 1500pF
C113	2113945A10	CAP, 1500pF
C114	2113945A10	CAP, 1500pF
C115	2313960B01	CAP, 1uF
C116	2113946K02	CAP, 100000pF
C117	2113945L25	CAP, 1000pF
C120	2113945A10	CAP, 1500pF
C121	2113945A10	CAP, 1500pF
C122	2113944C32	CAP, 15pF
C123	2113944C32	CAP, 15pF
C124	2113945A10	CAP, 1500pF
C130	2113944C31	CAP, 12pF
C131	2113944C18	CAP, 3.3pF
C132	2113944C35	CAP, 27pF
C133	2113944C18	CAP, 3.3pF
C134	2113944C35	CAP, 27pF
C135	2113944C20	CAP, 3.9pF
C136	2113944C78	CAP, 13pF
C137	2113944C89	CAP, 20pF0
C140	2113944C78	CAP, 13pF
C141	2113944C33	CAP, 18pF
C150	2113945A10	CAP, 1500pF
C151	2113945A10	CAP, 1500pF
C152	2113945A10	CAP, 1500pF
C153	2113946L04	CAP, 0.47uF
C154	2113945A10	CAP, 1500pF
C155	2113945C31	CAP, 0.10uF
C156	2113945B02	CAP, 10000pF
C157	2113946K02	CAP, 100000pF
C158	2113945A10	CAP, 1500pF
C159	2113945A10	CAP, 1500pF
C170	2113946K02	CAP, 100000pF
C171	2113944A11	CAP, 2.7pF
C172	2113945A10	CAP, 1500pF
C201	2113944C02	CAP, 220pF
C202	2115153H52	CAP, 68pF
C203	2115153H13	CAP, 2.7pF
C204	2113945A05	CAP, 470pF
C205	Not_Placed	-
C206	Not_Placed	-
C207	2113945A05	CAP, 470pF
C208	2113945A05	CAP, 470pF
C209	2113945A05	CAP, 470pF
C210	2113945A05	CAP, 470pF
C211	2113945C31	CAP, 0.10uF
C212	2113946N03	CAP, 2.2uF
C213	2113945B02	CAP, 10000pF
C214	2113945A09	CAP, 1000pF
C215	2113946N03	CAP, 2.2uF
C216	2113945C31	CAP, 0.10uF
C217	2113945A09	CAP, 1000pF
C218	2113946N03	CAP, 2.2uF
C219	2113945C31	CAP, 0.10uF
C220	2113944A29	CAP, 22pF
C221	2113945B02	CAP, 10000pF
C222	2113945B02	CAP, 10000pF
C223	2113945B02	CAP, 10000pF
C224	2113945B02	CAP, 10000pF
C225	2313960D07	CAP, 10uF
C226	2313960D07	CAP, 10uF
C227	2113945A09	CAP, 1000pF
C228	2113945C31	CAP, 0.10uF
C230	2113946N03	CAP, 2.2uF
C231	2113945A09	CAP, 1000pF
C232	2113945C31	CAP, 0.10uF
C233	2313960B30	CAP, 4.7pF
C241	2113945A60	CAP, 1200pF
C243	2113945G91	CAP, 100000pF
C244	2113945L27	CAP, 1200pF
C245	2313960C26	KEMET CAP
C251	2113945L49	CAP, 1000pF
C253	2115153H38	CAP, 16pF
C254	2115153H15	CAP, 3.3
C255	2115153H39	CAP, 18pF
C256	2115153H27	CAP, 10pF
C257	2115153H46	CAP, 36pF
C258	2113945A60	CAP, 1200pF
C263	2115153H43	CAP, 27pF
C264	2115153H19	CAP, 4.7
C265	2115153H37	CAP, 15pF
C266	2115153H27	CAP, 10pF
C267	2115153H46	CAP, 36pF
C268	2115153H13	CAP, 2.7pF
C269	2113945A10	CAP, 1500pF
C270	2113945A60	CAP, 1200pF
C271	2113945B02	CAP, 10000pF
C272	2113945C31	CAP, 0.10uF
C273	2113945B02	CAP, 10000pF
C274	2113945C31	CAP, 0.10uF
C275	2113945A60	CAP, 1200pF
C276	2113944A18	CAP, 5.1pF
C277	2113945A60	CAP, 1200pF
C281	2113945A60	CAP, 1200pF
C282	2113944A24	CAP, 9.1pF
C283	2113945A60	CAP, 1200pF
C284	2113945A60	CAP, 1200pF
C285	2113945C31	CAP, 0.10uF
C286	2113944A77	CAP, 11pF
C290	2113944A85	CAP, 51pF
C291	2113944A83	CAP, 36pF
C292	2113945A60	CAP, 1200pF
C293	2113945A05	CAP, 470pF
C301	2113945A04	CAP, 390pF
C302	2113945A04	CAP, 390pF
C303	2313960F04	CAP, 33uF
C304	2113945B02	CAP, 10000pF
C305	2113944A40	CAP, 100pF
C306	2113945L49	CAP, 1000pF
C310	2113945B02	CAP, 10000pF
C311	2113743E05	CAP, 0.18uF
C312	2313960D07	CAP, 10uF
C313	2113945B02	CAP, 10000pF
C314	2113945A60	CAP, 1200pF
C315	2113945A60	CAP, 1200pF
C316	2113945A60	CAP, 1200pF
C320	2113743E05	CAP, 0.18uF
C321	2313960D07	CAP, 10uF
C322	2113945B02	CAP, 10000pF
C323	2113944A42	CAP, 150pF
C331	2113945B02	CAP, 10000pF
C333	2113945B02	CAP, 10000pF
C334	2313960D07	CAP, 10uF
C400	Not_Placed	-
C401	2113946K02	CAP, 100000pF
C402	2113945A09	CAP, 1000pF
C403	2113944A40	CAP, 100pF
C404	2113945A09	CAP, 1000pF
C405	2113944A40	CAP, 100pF
C406	2113944A40	CAP, 100pF
C407	2113945A09	CAP, 1000pF
C408	2113945A09	CAP, 1000pF
C409	2113945A09	CAP, 1000pF

Circuit Ref	Motorola Part No.	Description
C410	2313960D07	CAP, 10uF
C411	2113946K02	CAP, 100000pF
C412	2113945A09	CAP, 1000pF
C413	2113946K02	CAP, 100000pF
C414	2113946K02	CAP, 100000pF
C415	2113945A09	CAP, 1000pF
C416	2113945A09	CAP, 1000pF
C417	2113945A09	CAP, 1000pF
C418	2113946K02	CAP, 100000pF
C419	2113945A09	CAP, 1000pF
C420	2113945B02	CAP, 10000pF
C421	2113945B02	CAP, 10000pF
C422	2113945B02	CAP, 10000pF
C425	2113946E02	CAP, 1uF
C426	2313960B01	CAP, 1uF
C430	2113946K02	CAP, 100000pF
C431	2113945A09	CAP, 1000pF
C432	2113946K02	CAP, 100000pF
C433	2113945A09	CAP, 1000pF
C440	2113945B02	CAP, 10000pF
C441	2113945B02	CAP, 10000pF
C442	2113945B02	CAP, 10000pF
C443	2113945B02	CAP, 10000pF
C444	2113945B02	CAP, 10000pF
C445	2113945B02	CAP, 10000pF
C446	2113945B02	CAP, 10000pF
C447	2113946K02	CAP, 100000pF
C451	2113946K02	CAP, 100000pF
C452	2113945C31	CAP, 0.10uF
C453	2313960B30	CAP, 4.7pF
C454	2113945C31	CAP, 0.10uF
C455	2113945B04	CAP, 22000pF
C456	2113945C31	CAP, 0.10uF
C457	2113945C31	CAP, 0.10uF
C458	2113945C31	CAP, 0.10uF
C459	2113945C31	CAP, 0.10uF
C460	2113945C31	CAP, 0.10uF
C461	2113946F03	CAP, 4.7uF
C462	2113945C31	CAP, 0.10uF
C463	2113945C31	CAP, 0.10uF
C464	2113945C31	CAP, 0.10uF
C465	2113945A09	CAP, 1000pF
C466	Not_Placed	-
C467	2113945A60	CAP, 1200pF
C470	2113945C31	CAP, 0.10uF
C471	2113946N03	CAP, 2.2uF
C472	2113945C31	CAP, 0.10uF
C473	2113944A42	CAP, 150pF
C474	2113944A42	CAP, 150pF
C475	2113945B04	CAP, 22000pF
C476	2113945B04	CAP, 22000pF
C477	2113946K02	CAP, 100000pF
C478	2113944A42	CAP, 150pF
C479	2113944A42	CAP, 150pF
C480	2113945C31	CAP, 0.10uF
C481	Not_Placed	-
C482	Not_Placed	-
C483	2113946C02	CAP, 0.22uF
C484	Not_Placed	-
C488	2113945A05	CAP, 470pF
C489	2113945A05	CAP, 470pF
C490	2113945A05	CAP, 470pF
C492	2113928J08	CAP, 10uF
C493	2113945A09	CAP, 1000pF
C494	2113946N03	CAP, 2.2uF
C495	2113946N02	CAP, 1uF
C496	2113946N02	CAP, 1uF
C497	2113945C31	CAP, 0.10uF
C498	2113946N02	CAP, 1uF
C499	2113944A32	CAP, 39pF
C500	2113945A09	CAP, 1000pF
C501	2113946N02	CAP, 1uF
C503	2113945A09	CAP, 1000pF
C504	2113945A09	CAP, 1000pF
C505	2113945A09	CAP, 1000pF
C506	2113945A09	CAP, 1000pF
C507	2113945A09	CAP, 1000pF
C511	2113944C02	CAP, 220pF
C512	2113944A21	CAP, 6.8pF
C513	2113944C02	CAP, 220pF
C514	2113944A79	CAP, 16pF
C518	2113945C31	CAP, 0.10uF
C519	2113946N02	CAP, 1uF
CR1	4813974A19	Diode Schottky
CR41	4815923H01	Diode Schottky
CR51	4813974A19	Diode Schottky
D51	4815047H01	Switching Diode
D52	4815047H01	Switching Diode
D120	4880973Z02	Pin Diode
D121	4880973Z02	Pin Diode
D201	4815072H01	Diode Varactor
D220	4815011H01	Diode Triple
D221	4815011H01	Diode Triple
D251	4813974A01	ISV 228
D261	4813974A01	ISV 228
D262	4885055Y01	Diode Varactor
D301	4815713H01	Diode Schottky
D414	4816064H01	RH29M19 LH
D424	4809924D29	Diode High Voltage
D425	4816064H01	RH29M19 LH
D440	4805729G49	Diode Red/Yel
D470	4809924D29	Diode High Voltage
D471	4809924D29	Diode High Voltage
D491	Not_Placed	-
E451	2480640Z01	Ferrite Bead
E452	2480640Z01	Ferrite Bead
E453	2480640Z01	Ferrite Bead
E500	2480640Z01	Ferrite Bead
F301	6515076H01	Fuse Chip SMT
FL51	9186801Z01	OSC,XTAL 44.85MHZ
FL52	9180468V04	4 Element FLTR
FL53	9180469V05	6 Element FLTR
FL54	9115811H01	6 Element FLTR
J140	0986428Z02	RF Jack
J301	0986565Z02	Battery CONN
J460	Not_Placed	-
J470	0985818A02	CONN 2 PIN
J471	0980683Z03	AUDIO JACK
J491	2815162H01	CONN_P
L1	2414015C09	INDCTR, 68nH
L2	2414015C09	INDCTR, 68nH
L3	2414015C09	INDCTR, 68nH
L4	2414015C09	INDCTR, 68nH
L21	Not_Placed	-
L22	2414017N24	INDCTR, 100nH
L31	2414015C09	INDCTR, 68nH
L32	2414015C09	INDCTR, 68nH
L33	2414015C09	INDCTR, 68nH
L40	2414015C09	INDCTR, 68nH
L41	2414015C09	INDCTR, 68nH
L51	2414017N26	INDCTR, 150nH
L52	2414032F44	INDCTR, 680nH
L53	2113944A41	CAP, 120 pF
L54	2414015A25	INDCTR, 1200nH
L81	2414015A19	INDCTR, 1000nH
L100	2414017K32	INDCTR, 560nH
L101	2414017K32	INDCTR, 560nH
L102	2415429H36	INDCTR, 100nH
L103	2415429H25	INDCTR, 30nH
L110	2414017K32	INDCTR, 560nH
L120	2414017K32	INDCTR, 560nH
L121	2415015H01	INDCTR, 47nH
L130	2479990N01	INDCTR, 43.67nH
L131	2479990N01	INDCTR, 43.67nH
L132	2479990N01	INDCTR, 43.67nH
L140	2479990M01	INDCTR, 30.54nH
L211	2414017K32	INDCTR, 560nH
L251	2414017K32	INDCTR, 560nH
L252	2414017K32	INDCTR, 560nH
L253	2415429H36	INDCTR, 100nH
L254	2414015C05	INDCTR, 33nH
L255	2414017K29	INDCTR, 330nH
L262	2414017K32	INDCTR, 560nH
L263	2415429H36	INDCTR, 100nH
L264	2414015C07	INDCTR, 47nH
L265	2414017K29	INDCTR, 330nH
L270	2414017K32	INDCTR, 560nH
L271	Not_Placed	-
L276	2414017N24	INDCTR, 100nH
L281	2414017N22	INDCTR, 68nH
L282	2414017N20	INDCTR, 47nH
L283	Not_Placed	-
L291	2414017N17	INDCTR, 27nH
L292	2414017N22	INDCTR, 68nH
L471	2414017K30	INDCTR, 390nH
M140	0286427Z01	Nut, Antenna
Q21	4815119H01	Transistor
Q22	4815267H01	Transistor
Q51	4815343H01	Transistor
Q70	4815056H01	Transistor
Q100	4815119H01	Transistor
Q150	4815056H01	Transistor
Q170	4809939C34	Transistor
Q171	4815056H01	Transistor
Q280	4815119H01	TRANSISTOR
Q311	4815069H02	TP010IT
Q312	4815069H02	TP010IT
Q313	4815066H01	Transistor
Q402	4813973A42	Transistor
Q403	4813973A13	XSTR PNP40V
Q410	4815066H01	Transistor
Q425	4815069H02	TP010IT
Q426	4815069H02	TP010IT
Q427	4815069H02	TP010IT
Q440	4815154H01	Transistor
Q470	4815267H01	Transistor
Q471	4815066H01	Transistor
Q472	4815267H01	Transistor
Q481	Not_Placed	-
Q482	Not_Placed	-
Q490	4815066H01	Transistor
Q493	4815069H02	TP010IT
Q494	4815066H01	Transistor
Q520	4815154H01	Transistor
R20	0613952Z52	RES, 6.8K
R21	0613952Q49	RES, 100
R22	0613952Q93	RES, 6800
R23	0613952Z58	RES, 22K
R24	0613952Q70	RES, 750
R25	0613952Q91	RES, 5600
R26	0613952R66	RES, 0
R40	0613952Q73	RES, 1000
R51	0613952Q42	RES, 51
R52	0613952R03	RES, 12K

Circuit Ref	Motorola Part No.	Description
R53	0613952R13	RES, 33K
R54	0613952Q90	RES, 5100
R55	0613952Q61	RES, 330
R57	0613952Q89	RES, 4700
R60	0613952Q82	RES, 2400
R61	0613952R25	RES, 100K
R62	0613952Q85	RES, 3300
R63	0613952R15	RES, 39K
R64	0613952R08	RES, 20K
R65	0613952R15	RES, 39K
R66	0613952R08	RES, 20K
R67	0613952R08	RES, 20K
R72	0613952Q63	RES, 390
R73	0613952Q79	RES, 1800
R74	0613952Q75	RES, 1200
R75	0613952R03	RES, 12K
R76	0613952Z55	RES, 12K
R77	0613952Z53	RES, 8.2K
R78	0613952Q69	RES, 680
R80	0613952Q90	RES, 5100
R81	0613952Q73	RES, 1000
R82	Not_Placed	-
R90	0613952Q42	RES, 51
R91	0613952Q78	RES, 1600
R100	0613952Q60	RES, 300
R101	0613952Q31	RES, 18
R102	0613952Q60	RES, 300
R103	0613952Q85	RES, 3300
R104	0613952H42	RES, 51
R105	0613952Q75	RES, 1200
R106	0613952Q89	RES, 4700
R107	0613952Q53	RES, 150
R110	0613952Q62	RES, 360
R111	0613952R01	RES, 10K
R120	0613958H53	RES, 150
R121	0613958H53	RES, 150
R150	0680539Z01	RES, 0.1
R151	0613952H33	RES, 22
R152	0613952P01	RES, 100K
R153	0613952P01	RES, 100K
R154	0613952P01	RES, 100K
R155	0613952P01	RES, 100K
R156	0613952Q61	RES, 330
R157	0613952Q91	RES, 5600
R158	0613952Q77	RES, 1500
R162	0613952R01	RES, 10K
R171	0613952Q93	RES, 6800
R202	0613952R29	RES, 150K
R205	0613952Q49	RES, 100
R206	Not_Placed	-
R212	0613958J74	RES, 0
R220	0613952Q53	RES, 150
R221	0613952Q53	RES, 150
R223	0613952Q49	RES, 100
R227	0613952R29	RES, 150K
R230	0613952R26	RES, 110K
R243	0613952Q79	RES, 1800
R244	0613952Q42	RES, 51
R245	0613952Q77	RES, 1500
R246	0613952R25	RES, 100K
R247	0613952R30	RES, 160K
R248	0613952Q42	RES, 51
R253	0613952Q41	RES, 47
R254	0613952Q57	RES, 220
R255	0613952Z46	RES, 3.9K
R261	0613952R18	RES, 51K
R262	0613952Q93	RES, 6800
R263	0613952Q36	RES, 30
R264	0613952Q57	RES, 220
R270	0613952Q31	RES, 18
R271	0613952Q95	RES, 8200
R272	0613952Q96	RES, 9100 2
R273	0613952Q60	RES, 300
R274	0613952Q37	RES, 33
R275	0613952R66	RES, 0
R276	0613952Q73	RES, 1000
R280	0613952Q93	RES, 6800
R281	0613952Q96	RES, 9100 2
R282	0613952Q70	RES, 750
R283	0613952Q55	RES, 180
R284	0613952Q61	RES, 330
R286	0613952R66	RES, 0
R310	0613952R25	RES, 100K
R311	0613952R25	RES, 100K
R312	0613952R08	RES, 20K
R313	0613952Q90	RES, 5100
R320	0613952Z80	RES, 330K
R321	0613952P30	RES, 200K
R322	0613952R25	RES, 100K
R400	Not_Placed	-
R401	0613952R36	RES, 300K
R402	0613952R01	RES, 10K
R403	0613952R01	RES, 10K
R404	0613952R18	RES, 51K
R405	0613952R36	RES, 300K
R406	0613952R33	RES, 220K
R407	0613952R25	RES, 100K
R408	0613952R25	RES, 100K
R409	0613952Q73	RES, 1000
R410	0613952R01	RES, 10K
R411	0613952Q71	RES, 820
R412	0613952R25	RES, 100K
R413	0613952R25	RES, 100K
R414	0613952R13	RES, 33K
R415	0613952R13	RES, 33K
R416	0613952R08	RES, 20K
R417	0613952R01	RES, 10K
R418	0613952R25	RES, 100K
R419	0613952Q89	RES, 4700
R420	0613952P30	RES, 200K
R421	0613952P01	RES, 100K
R422	0613952R25	RES, 100K
R423	0613952R25	RES, 100K
R424	0613952P30	RES, 200K
R425	0613952P01	RES, 100K
R430	0613952R25	RES, 100K
R431	Not_Placed	-
R432	0613952R66	RES, 0
R433	0613952R25	RES, 100K
R434	Not_Placed	-
R440	0613952Q89	RES, 4700
R441	0613952Q89	RES, 4700
R442	0613952H57	RES, 220
R443	0613952H51	CHIP RES 120
R445	0613952Q89	RES, 4700
R446	0613952R01	RES, 10K
R451	0613952R17	RES, 47K
R460	0613952R10	RES, 24K
R462	0613952R10	RES, 24K
R463	0613952R10	RES, 24K
R464	0613952R12	RES, 30K
R469	0613952Q25	RES, 10
R470	0613952Q81	RES, 2200
R471	0613952Q81	RES, 2200
R472	0613952Q69	RES, 680
R473	0613952Q69	RES, 680
R474	0613952H61	RES, 330
R475	0613952R31	RES, 180K
R476	0613952R25	RES, 100K
R477	0613952Q81	RES, 2200
R478	0613952Q81	RES, 2200
R479	0613952R25	RES, 100K
R480	0613952G67	RES, 0
R481	Not_Placed	-
R482	Not_Placed	-
R483	Not_Placed	-
R484	Not_Placed	-
R485	Not_Placed	-
R486	Not_Placed	-
R487	0613952R66	RES, 0
R488	0613952R37	RES, 330K
R489	Not_Placed	-
R490	Not_Placed	-
R491	0613952R66	RES, 0
R492	0613952R10	RES, 24K
R493	0613952R37	RES, 330K
R494	0613952Z80	RES, 330K
R495	0613952Q91	RES, 5600
R496	Not_Placed	-
R497	Not_Placed	-
R498	Not_Placed	-
R499	Not_Placed	-
R501	0613952Q49	RES, 100
R502	0613952Q49	RES, 100
R503	0613952Q49	RES, 100
R504	0613952Q49	RES, 100
R505	0613952Q49	RES, 100
R506	0613952Q49	RES, 100
R507	0613952Q49	RES, 100
R508	0613952R25	RES, 100K
R509	0613952R25	RES, 100K
R510	0613952R37	RES, 330K
R511	0613952R25	RES, 100K
R512	0613952R29	RES, 150K
R513	Not_Placed	-
R514	0613952R25	RES, 100K
R515	Not_Placed	-
R516	Not_Placed	-
R517	0613952R66	RES, 0
R518	0613952R33	RES, 220K
R519	0613952R25	RES, 100K
R520	0613952R25	RES, 100K
R521	Not_Placed	-
R522	0613952R25	RES, 100K
R523	0613952R01	RES, 10K
R524	0613952R01	RES, 10K
S440	4080710Z24	Switch
	4080710Z26	Switch
S441	4070354A01	Switch
S442	4070354A01	Switch
S443	4070354A01	Switch
S444	1880619Z04	Potentiometer
SH1	2686421Z02	Shield
SH40	2686419Z02	Shield
SH50	2686423Z02	Shield
SH52	2686424Z02	Shield
SH100	2686418Z02	Shield
SH200	2686424Z02	Shield
SH201	2686423Z02	Shield
SH250	2686425Z02	Shield
SH251	2686425Z02	Shield
SH253	2686422Z02	Shield
SH400	2686420Z03	Shield
SH401	2686420Z03	Shield

Circuit Ref	Motorola Part No.	Description
T41	2515121H01	Balun Transformer
T42	2515121H01	Balun Transformer
U51	5115281H01	SA616
U52	5115070H01	TC7W04FU
U110	0178034A01	PA Module
U150	5114005A01	LM2904DR
U151	2415954H01	INDCTR Bead
U201	5185177Y01	AT25016
U251	5105750U56	VCO Buffer IC
U310	5115746H01	Voltage Regulator
U320	5115679H01	Voltage Regulator
U330	5115745H01	Voltage Regulator
U401	5185143E03	68HC11FLO
U402	5115033H01	EEPROM IC
U403	Not_Placed	-
U404	5115032H01	Flash 128K
U425	5115697H01	OP AMP
U451	5115062H01	IC ASFIC_CMP_R1
U480	Not_Placed	-
U490	9115811H03	Audio Amplifier
U510	5114005A01	LM2904DR
U511	4815066H01	Transistor
VR110	4813977A55	Diode Zener
VR301	4813977M29	Diode 20V
VR302	4813977M29	Diode 20V
VR471	4813977M14	Diode 6.8V
VR472	4813977M05	Diode 3.3V
VR473	4813977M29	Diode 20V
VR474	4813977M29	Diode 20V
VR475	4813977M24	Diode Zener
Y51	4802245J84	XTAL 44.395MHz
Y70	9186145B02	CDBCA455CX36-TC
Y201	4880114R06	Crystal 16.8MHZ
Y202	Not_Placed	-

Chapter 7 VHF Schematic Diagrams, Overlays, and Parts Lists

7.1 Introduction

This section provides schematic diagrams, overlays, and parts lists for the radio circuit boards and interface connections.

7.1.1 Notes For All Schematics and Circuit Boards

* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

1. Unless otherwise stated, resistance values are in ohms (K = 1000), capacitance values are in picofarads (pF) or microfarads (µF), and inductance values are in nanohenries (nH) or microhenries (µH).
2. DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. If the board has been removed from the chassis, the transmitter module mounting screws may be used for ground connection. (*Note: The antenna nut bracket is not connected to ground.*) Operating mode dependent voltages are followed by (RX) for receive mode, (TX) for transmit mode, (UNSQ) for unsquelched mode, etc.
3. RF voltages on VHF models are measured with a Fluke model 85 RF probe. The indicated voltages expressed in mV (RF) are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 100 mV (-7 dBm) RF signal applied to the antenna jack J140.
4. RF voltages on UHF models are measured both with a high-impedance RF voltmeter having a bandwidth in excess of 500 MHz (levels are expressed in dBm) and with a Fluke model 85 RF probe [levels are expressed in mV (RF)]. These indicated voltages are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms, and are only approximate for UHF frequency measurements. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 100 mV (-7 dBm) RF signal applied to the antenna jack J140.
5. Audio voltages are measured with a high-impedance AC rms voltmeter. The indicated voltages are expressed in mV rms. Receive mode voltages are followed by (RX) and are measured with an on-channel signal with 1 kHz modulation at 60% deviation (3 kHz for 25 kHz channels, or 1.5 kHz for 12.5 kHz channels). Transmit mode voltages are followed by (TX) and are measured with a 1 kHz, 10 mV rms signal present at the external microphone input (accessory connector J471 pin 4 hot and pin 7 ground).
6. Reference Designators are assigned in the following manner:

Ref. No. Series	Circuit Block
1-99	RF Front End
100-149	Transmitter RF Stages
150-200	Transmitter Power Control
201-250	Frequency Synthesizer
251-300	VCO

Ref. No. Series	Circuit Block
301-400	DC Regulation
401-450	Microprocessor
451-550	Audio

7. Circuit Block Interconnection Legend:

Name	Description
USWB+	Unswitched Battery Voltage (always on)
5V	5 volts (regulated)
5R	5 volts in RX mode only
5T	5 volts in TX mode only
RESET	Low-line reset signal from U320 to uP
D3_3V	Digital 3.3 volts (regulated)
3V	Analog 3 volts (regulated)
TX_ENA	Transmit enable signal from uP to transmitter
PWR_SET	DC voltage from ASFIC to TX power control
DEMOD	RX audio from backend to ASFIC
BW_SEL	Backend filter BW select from ASFIC
RSSI	RX signal strength indication from IFIC to uP
IF_IN/OUT	44.85 MHz from 1st mixer to high IF filter
RF_IN/OUT	RX signal from antenna switch to front end
MOD OUT/IN	TX modulation from ASFIC to synthesizer
16_8_MHZ	Ref osc signal from synthesizer to ASFIC
SYNTH_CS	Synthesizer chip select from uP
SPI_CLK	Serial clock from uP
SPI_DATA_OUT	Serial data from uP
LOCK	Lock detect indication from synth to uP
PRESC	VCO freq feedback from VCOBIC to synth
V_STEER	Steering line voltage from synth to VCO's
V_SF	Super-filtered 4.5 volts from synth to VCOBIC
VCO_MOD	TX modulation from ASFIC to synthesizer
TRB	TX/RX control from synth to VCOBIC
RX_INJ	Buffered RX VCO output to RX 1st mixer
TX_INJ	TX VCO output to transmitter input

7.1.2 Six Layer Circuit Board

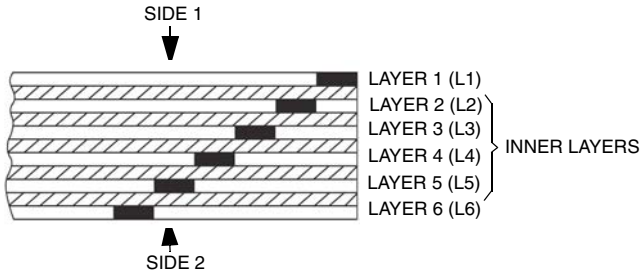


Figure 7-1. Six-Layer Circuit Board: Copper Steps in Layer Sequence

7.2 Speaker and Microphone Schematic

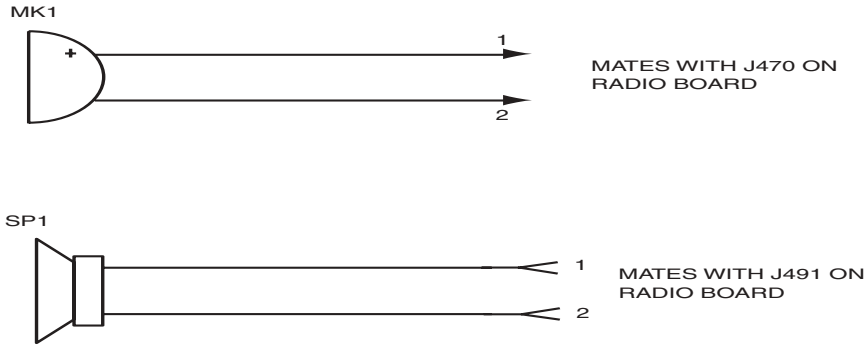


Figure 7-2. Speaker and Microphone Schematic

7.2.1 Speaker and Microphone Parts List

Reference Designator	Motorola Part No.	Description
MK1	5080258E16	Microphone, electret
SP1	5005679X04	Speaker assembly with connector

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Chapter 8 403-440 MHz UHF Theory Of Operation

8.1 Introduction

This chapter provides a detailed theory of operation for the radio components. Schematic diagrams for the circuits described in the following paragraphs are located in Chapter 12 of this manual.

8.2 UHF Receiver

The UHF receiver covers the range of 403-440 MHz and provides switchable IF bandwidth for use with 20/25/30 kHz or 12.5 kHz channel spacing systems. The receiver is divided into two major blocks, as shown in Figure 8-1.

- Front End
- Back End

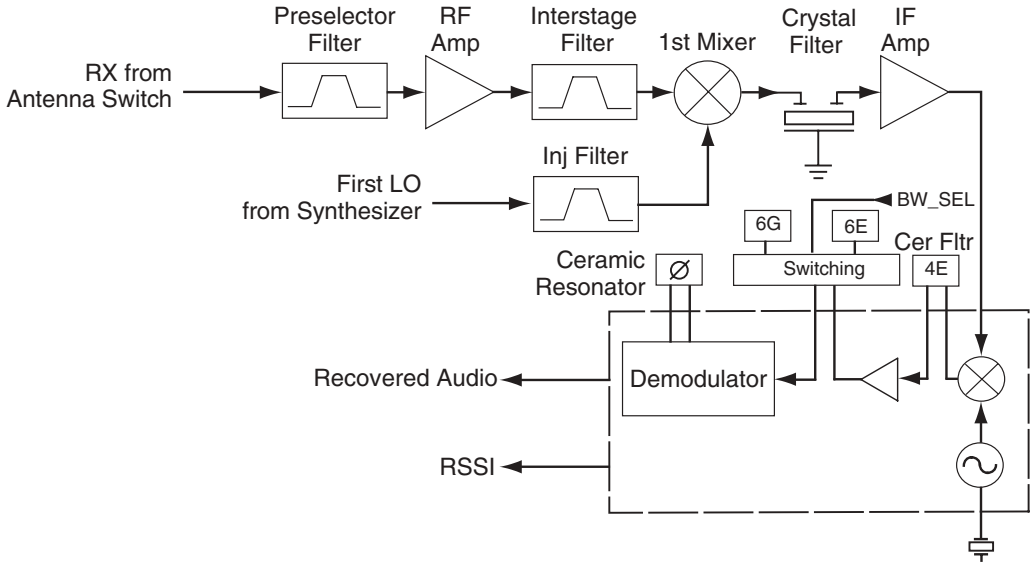

Figure 8-1. UHF Receiver Block Diagram

8.2.1 Receiver Front End

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, an interstage filter, and a double-balanced first mixer.

The preselector filter is a fixed-tuned 3-pole Butterworth design using discrete elements (L1-L3, C1-C10, C12 and C523) in a shunt-resonator configuration. It has a 3 dB bandwidth of 68 MHz centered at 421 MHz, an insertion loss of 2.2 dB and image attenuation of 38 dB at 350 MHz. Diode CR1 protects the RF amplifier by limiting excessive RF levels. The filter bandwidth is considerably wider than the receive band, to achieve low insertion loss in a compact size. C523 provides a transmission-zero to improve image attenuation.

The output of the filter is matched to the base of RF amplifier Q21, which provides 18 dB of gain and a noise figure of 4 dB. A BFS505 device is used for high gain, low noise figure and reduced operating current. Operating voltage is obtained from the 5R source, which is turned off during transmit to reduce dissipation in Q21. Current mirror Q22 maintains the operating current of Q21 constant at 8 mA regardless of device and temperature variations, for optimum dynamic range and noise figure.

The output of the RF amplifier is applied to the interstage filter, a fixed-tuned 4-pole Butterworth shunt-coupled resonator design having a 3 dB bandwidth of 68 MHz centered at 462 MHz, and insertion loss of 3.5 dB. This filter yields an image rejection of 58 dB at 350 MHz, assisted by a transmission-zero at 300 MHz implemented by C524 for the reasons mentioned above.

The output of the interstage filter is connected to the passive double-balanced mixer consisting of components T41, T42, and CR41. This mixer has a conversion loss of 7.2 dB. Low-side injection from the frequency synthesizer is filtered by L40-L41 and C41-C45 to remove second harmonic energy that may degrade half-IF spurious rejection performance. The injection filter has a 3 dB bandwidth of 100 MHz centered at 376.15 MHz, and an insertion loss of 2.7 dB. The second-harmonic rejection is typically 45 dB or greater. The filtered injection signal is applied to T42 at a level of +6 dBm.

The mixer output is applied to a diplexer network (L51-L52, C51, R51) which matches the 44.85 MHz IF signal to crystal filter FL51, and terminates the mixer into 50Ω at all other frequencies.

8.2.2 Receiver Back End

The receiver back end is a dual conversion design. High IF selectivity is provided by FL51, a 4-pole fundamental mode 44.85 MHz crystal filter with a minimum 3 dB bandwidth of ±6.7 kHz, a maximum 20 dB bandwidth of + 12.5 kHz, and a maximum insertion loss of 3.5 dB. The output is matched to IF amplifier stage Q51 by L53 and C93. Q51 provides 16 dB of gain and a noise figure of 1.8 dB. The dc operating current is 1 mA. The output of Q51 is applied to the input of the receiver IFIC U51. Diode CR51 limits the maximum RF level applied to the IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio and RSSI op amps. The second LO frequency, 44.395 MHz, is determined by Y51. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters, FL52 (between the second mixer and IF amp) and FL53 or FL54 (between the IF amp and the limiter input). The wider filter FL53 is used for 20/25 kHz channel spacing, and the narrower filter FL54 is used for 12.5 kHz channels. When the BW_SEL line is high, the two upper diodes in packages D51 and D52 are forward biased, selecting FL53 for 20/25 kHz channels. When the BW_SEL line is low, the two lower diodes in packages D51 and D52 are forward biased, selecting FL54 for 12.5 kHz channels.

The ceramic filters have the following specifications:

	FL52	**FL53**	**FL54**
Number of Elements:	4	6	6
Insertion Loss:	4 dB	4 dB	4 dB
6 dB Bandwidth:	15 kHz	15 kHz	9 kHz
50 dB Bandwidth:	30 kHz	30 kHz	22 kHz
Stopband Rejection:	27 dB	47 dB	47 dB

Ceramic resonator Y70 provides phase vs. frequency characteristic required by the quadrature detector, with 90 degree phase shift occurring at 455 kHz. Buffer Q70 provides a lower driving impedance from the limiter to the resonator, improving the IF waveform and lowering the distortion of the recovered audio signal. The recovered audio level at the DEMOD output is 120 mV rms (25 kHz channel, 3 kHz deviation) or 60 mV rms (12.5 kHz channel, 1.5 kHz deviation). An additional RSSI output provides a DC voltage level that is proportional to RF signal level. This voltage is measured by an A/D converter contained in the microprocessor (PE4_AN4, U401 pin 63).

8.3 UHF Transmitter

The UHF transmitter covers the range of 403-440 MHz. Depending on model, the output power of the transmitter is either switchable on a per-channel basis between high power (4 watts) and low power (1 watt), or is factory preset to 2 watts. The transmitter is divided into four major blocks as shown in Figure 8-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control.

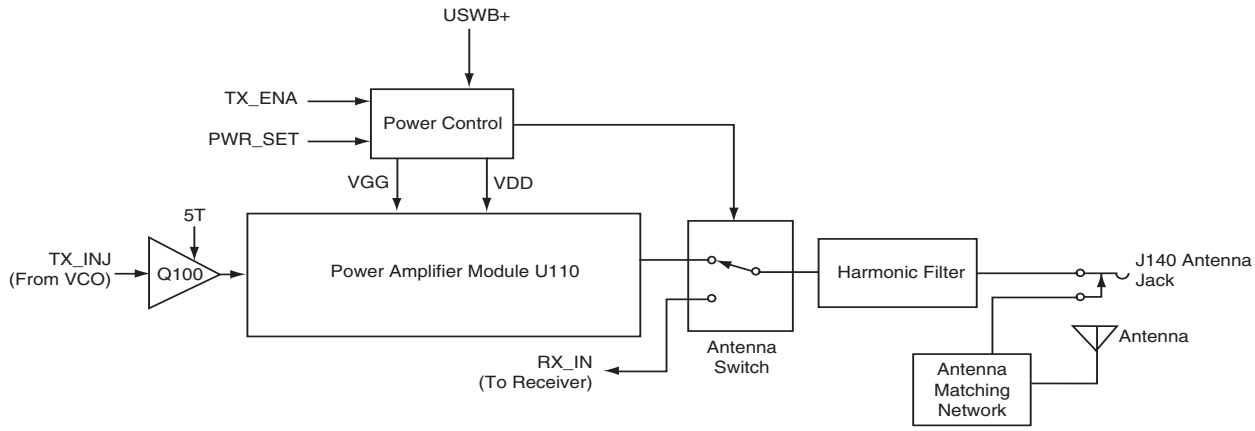

Figure 8-2. UHF Transmitter Block Diagram

8.3.1 Transmitter Power Amplifier

The transmitter power amplifier has three stages of amplification. The first stage, Q100, operates in Class A from the 5T source. It provides 17 dB of gain and an output of 50 mW. The current drain is typically 35mA. Components C105, C107 and L103 match the output of Q100 to the 50Ω input of the module U110.

U110 is a two stage Silicon MOS FET power amplifier module. Drain voltage is obtained from UNSW B+ after being routed through current-sense resistor R150 in the power control circuit. The output power of the module is controlled by varying the DC gate bias on U110 pin 2 (VGG).

8.3.2 Antenna Switch

The antenna switch consists of two pin diodes, D120 and D121. In the receive mode, both diodes are off. Signals applied at the antenna or at jack J140 are routed, via the harmonic filter, through network C122-C124 and L121, to the receiver input. In the transmit mode, Q170 is on and TXB+ is present, forward-biasing both diodes into conduction. The diode current is 20 mA, set by R120-R121. The transmitter RF from U110 is routed through D120, and via the harmonic filter to the antenna jack. D121 conducts, shunting RF power and preventing it from reaching the receiver. L121 is selected to appear as a 1/4 wave at UHF, so that the low impedance of D121 appears as a high impedance at the junction of D120 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

8.3.3 Harmonic Filter

The harmonic filter consists of components C122 (Range 1 UHF) C136 and L130-L132. The harmonic filter is a seven-pole Chebychev low-pass configuration, optimized for low insertion loss, with a 3 dB frequency of approximately 600 MHz and typically less than 0.8 dB insertion loss in the passband.

8.3.4 Antenna Matching Network

The harmonic filter presents a 50Ω impedance to antenna jack J140. A matching network, made up of C140-C141 and L140, is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the impedance presented by the antenna, significantly improving the antenna's efficiency.

8.3.5 Power Control

The power control circuit is a dc-coupled amplifier whose output is the dc gate bias voltage (VGG) applied to the two stages of the RF power amplifier U110.

The output power of the transmitter is adjusted by varying the setting of the power-set DAC contained in the ASFICcmp IC (DACG, U451 pin 6). This PWR_SET voltage is applied to U150 pin 3.

Stage U150-2 compares the voltage drop across current sense resistor R150 to the voltage drop across resistor R151 caused by current flow through Q150, and adjusts its output (pin 7) to maintain equal voltages at pins 5 and 6. Thus the current flow through Q150, and hence its emitter voltage, is proportional to the current drawn by stage U110, which is in turn proportional to the transmitter output power. The emitter voltage of Q150 is applied to U150 pin 2, where it is compared to the power set voltage PWR_SET at pin 3.

The output of U150 pin 1 is divided by R110 and R111 and applied as a gate voltage to the power amplifier U110. By varying this gate voltage as needed to keep the voltages at U150 pins 2 and 3 equal, power is maintained at the desired setting. Excessive final current, for example due to antenna mismatch, causes a lowering of the voltage at U150 pin 6, an increased voltage at pin 2, and a lowering of the voltage at pin 1 and of the gate voltage VGG. This prevents damage to the final stage due to excessive current.

8.4 UHF Frequency Generation Circuitry

The frequency generation system, shown in Figure 8-3, is composed of two circuit blocks, the Fractional-N synthesizer IC U201, the VCO/Buffer IC U251, and associated circuitry. Figure 8-4 shows the peripheral interconnect and support circuitry used in the synthesizer block, and Figure 8-5 details the internal circuitry of the VCOBIC and its interconnections to the surrounding components. Refer to the schematic to identify reference designators.

The Fractional-N synthesizer is powered by regulated 5 V and 3 V provided by U310 and U330 respectively. 5 V is applied to U201 pins 13 and 30, and 3 V is applied to pins 5, 20, 34 and 36. The synthesizer in turn generates a super-filtered 4.5 V supply (VSF, from pin 28) to power U251. In addition to the VCO, the synthesizer also interfaces with the logic and ASFICcmp circuits. Programming for the synthesizer is accomplished through the microprocessor SPI_DATA_OUT,

SPI_CLK, and SYNTH_CS (chip select) lines (U409 pins 100, 1 and 47 respectively). A logic high (3 V) from U201 pin 4 indicates to the microprocessor that the synthesizer is locked.

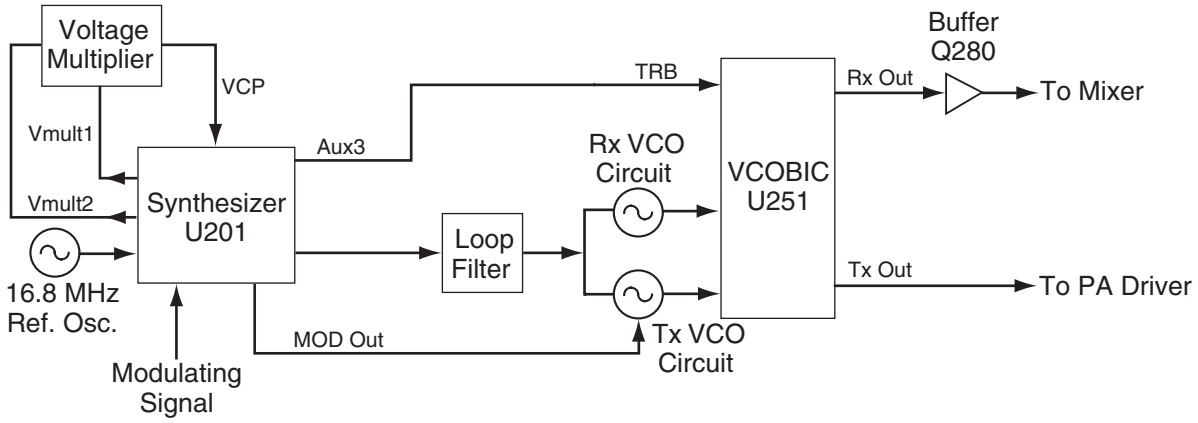

Figure 8-3. UHF Frequency Generation Unit Block Diagram

Transmit modulation from the ASFICcmp (U451 pin 40) is applied to U201 pin 10 (MOD_IN). An electronic attenuator in the ASFICcmp adjusts overall transmitter deviation by varying the audio level applied to the synthesizer IC. Internally the audio is digitized by the Fractional-N synthesizer and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for the purpose of balancing the low port and high port modulation and reducing the deviation by 6 dB for 12.5 kHz channels, and is available at U201 pin 41 (VCO_MOD). This audio signal is routed to the VCO's modulator.

8.4.1 Fractional-N Synthesizer

The Fractional-N synthesizer, shown in Figure 8-4, uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-C203, R202 and D201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor D201 from U201 pin 25 is determined by a temperature-compensation algorithm within U201, and is specific to each crystal Y201, based on a unique code assigned to the crystal that identifies its temperature characteristics. Stability is better than 2.5 ppm over temperatures of -30 to 60°C. Software-programmable electronic frequency adjustment is achieved by an internal DAC which provides a frequency adjustment voltage from U201 pin 25 to varactor D201.

The synthesizer IC U201 further divides the 16.8 MHz signal to 2.1 MHz, 2.225 MHz, or 2.4 MHz for use as reference frequencies. It also provides a buffered 16.8 MHz signal at U201 pin 19 for use by the ASFICcmp.

To achieve fast locking of the synthesizer, an internal adapt charge pump provides higher current at U201 pin 45 to quickly force the synthesizer within lock range. The required frequency is then locked by the normal mode charge pump at pin 43. A loop filter (C243-C245 and R243-R245) removes noise and spurs from the steering voltage applied to the VCO varactors, with additional filtering located in the VCO circuit.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C221-C224 and D220-D221. Two 3 V square waves from U201 pins 14-15 provide the drive signals for the voltage multiplier, which generates 12.1 V at U201 pin 47. This voltage is filtered by C225-C228.

One of the auxiliary outputs of the synthesizer IC (AUX3, U201 pin 2) provides the TRB signal which determines the operating mode of the VCO, either receive or transmit.

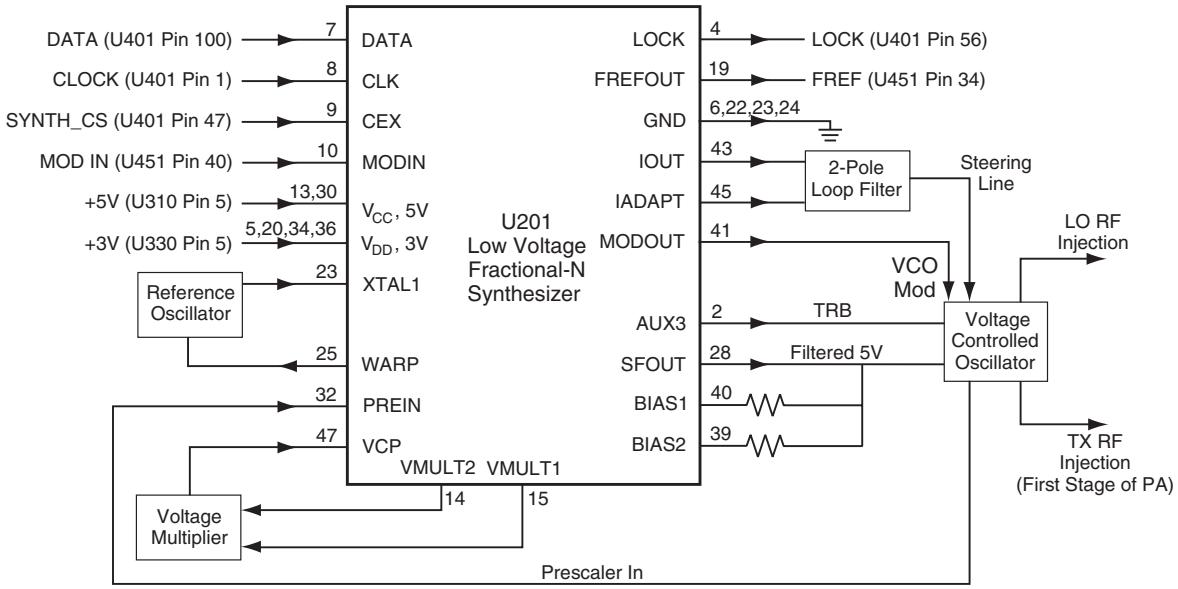

Figure 8-4. UHF Synthesizer Block Diagram

8.4.2 Voltage Controlled Oscillator (VCO)

The VCOBIC (U251), shown in Figure 8-5, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U251 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U251 pin 12 through a low pass filter, to the prescaler input of the synthesizer IC (U201 pin 32). After frequency comparison in the synthesizer, a resultant DC control voltage is used to steer the VCO frequency. When the PLL is locked on frequency, this voltage can vary between 3.5 V and 10 V. L251 and C252 further attenuate noise and spurs on the steering line voltage.

In the receive mode, the TRB line (U251 pin 19) is low. This activates the receive VCO and the receive buffer of U251, which operate within the range of 358.15 to 395.15 MHz. The VCO frequency is determined by tank inductor L254, C253-C257, and varactor D251. The buffered RF signal at U251 pin 8 is further amplified by Q280 and applied as RX_INJ to the low-pass injection filter in the receiver front end circuit.

In the transmit mode, U251-19 is driven high by U201 pin 2, enabling the transmit VCO and buffer. The 403-470 MHz RF signal from U251 pin 10 is applied as TX_INJ to the input of the transmitter circuit via matching network C290-C291 and L291. TX VCO frequency is determined by L264, C263-

C267, and varactor D261. High-port audio modulation from the synthesizer IC is applied as VCO_MOD to varactor D262 which modulates the transmit VCO.

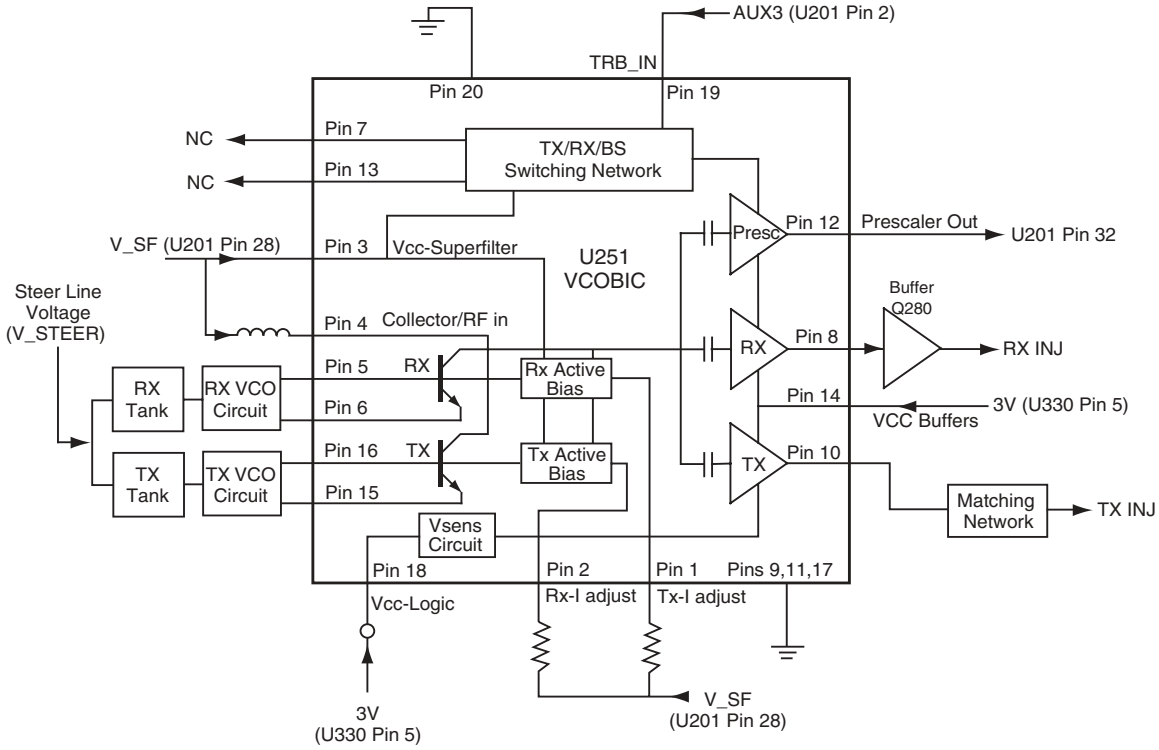

Figure 8-5. UHF VCO Block Diagram

Notes:

Chapter 9 438-470 MHz UHF Theory Of Operation

9.1 Introduction

This chapter provides a detailed theory of operation for the radio components. Schematic diagrams for the circuits described in the following paragraphs are located in Chapter 12 of this manual.

9.2 UHF Receiver

The UHF receiver covers the range of 438-470 MHz and provides switchable IF bandwidth for use with 20/25/30 kHz or 12.5 kHz channel spacing systems. The receiver is divided into two major blocks, as shown in Figure 9-1.

- Front End
- Back End

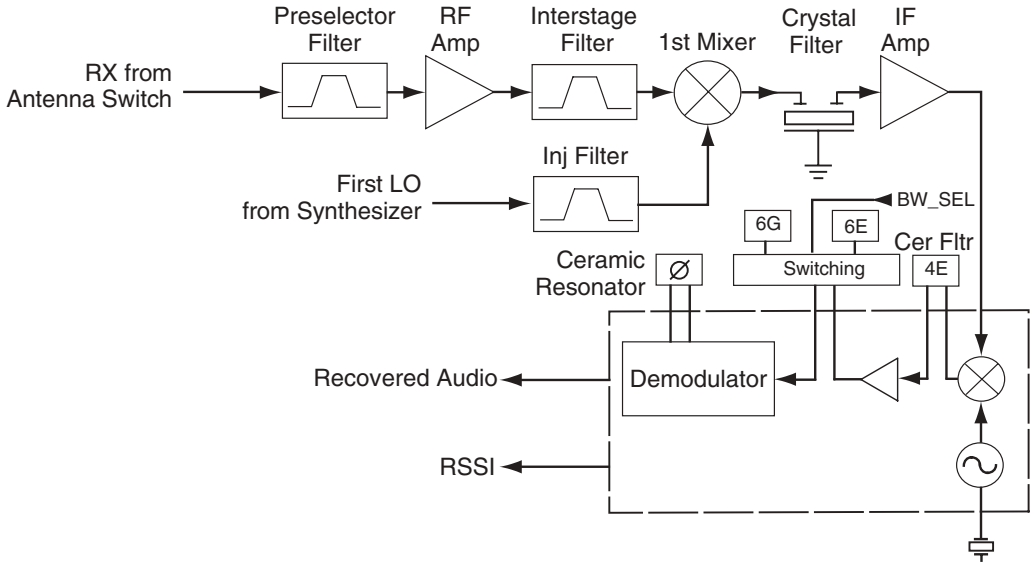

Figure 9-1. UHF Receiver Block Diagram

9.2.1 Receiver Front End

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, an interstage filter, and a double-balanced first mixer.

The preselector filter is a fixed-tuned 3-pole Butterworth design using discrete elements (L1-L3, C1-C10, C12 and C523) in a shunt-resonator configuration. It has a 3 dB bandwidth of 68 MHz centered at 460 MHz, an insertion loss of 2 dB and image attenuation of 35 dB at 380 MHz. Diode CR1 protects the RF amplifier by limiting excessive RF levels. The filter bandwidth is considerably wider than the receive band, to achieve low insertion loss in a compact size. C523 provides a transmission-zero to improve image attenuation.

The output of the filter is matched to the base of RF amplifier Q21, which provides 18 dB of gain and a noise figure of 4 dB. A BFS505 device is used for high gain, low noise figure and reduced operating current. Operating voltage is obtained from the 5R source, which is turned off during transmit to reduce dissipation in Q21. Current mirror Q22 maintains the operating current of Q21 constant at 8 mA regardless of device and temperature variations, for optimum dynamic range and noise figure.

The output of the RF amplifier is applied to the interstage filter, a fixed-tuned 4-pole Butterworth shunt-coupled resonator design having a 3 dB bandwidth of 68 MHz centered at 462 MHz, and insertion loss of 3 dB. This filter yields an image rejection of 48 dB at 380 MHz, assisted by a transmission-zero at 300 MHz implemented by C524 for the reasons mentioned above.

The output of the interstage filter is connected to the passive double-balanced mixer consisting of components T41, T42, and CR41. This mixer has a conversion loss of 7.2 dB. Low-side injection from the frequency synthesizer is filtered by L40-L41 and C41-C45 to remove second harmonic energy that may degrade half-IF spurious rejection performance. The injection filter has a 3 dB bandwidth of 100 MHz centered at 408 MHz, and an insertion loss of 2 dB. The second-harmonic rejection is typically 40 dB or greater. The filtered injection signal is applied to T42 at a level of +6 dBm.

The mixer output is applied to a diplexer network (L51-L52, C51, R51) which matches the 44.85 MHz IF signal to crystal filter FL51, and terminates the mixer into 50Ω at all other frequencies.

9.2.2 Receiver Back End

The receiver back end is a dual conversion design. High IF selectivity is provided by FL51, a 4-pole fundamental mode 44.85 MHz crystal filter with a minimum 3 dB bandwidth of ±6.7 kHz, a maximum 20 dB bandwidth of + 12.5 kHz, and a maximum insertion loss of 3.5 dB. The output is matched to IF amplifier stage Q51 by L53 and C93. Q51 provides 16 dB of gain and a noise figure of 1.8 dB. The dc operating current is 1 mA. The output of Q51 is applied to the input of the receiver IFIC U51. Diode CR51 limits the maximum RF level applied to the IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio and RSSI op amps. The second LO frequency, 44.395 MHz, is determined by Y51. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters, FL52 (between the second mixer and IF amp) and FL53 or FL54 (between the IF amp and the limiter input). The wider filter FL53 is used for 20/25 kHz channel spacing, and the narrower filter FL54 is used for 12.5 kHz channels. When the BW_SEL line is high, the two upper diodes in packages D51 and D52 are forward biased, selecting FL53 for 20/25 kHz channels. When the BW_SEL line is low, the two lower diodes in packages D51 and D52 are forward biased, selecting FL54 for 12.5 kHz channels.

The ceramic filters have the following specifications:

	FL52	**FL53**	**FL54**
Number of Elements:	4	6	6
Insertion Loss:	4 dB	4 dB	4 dB
6 dB Bandwidth:	15 kHz	15 kHz	9 kHz
50 dB Bandwidth:	30 kHz	30 kHz	22 kHz
Stopband Rejection:	27 dB	47 dB	47 dB

Ceramic resonator Y70 provides phase vs. frequency characteristic required by the quadrature detector, with 90 degree phase shift occurring at 455 kHz. Buffer Q70 provides a lower driving impedance from the limiter to the resonator, improving the IF waveform and lowering the distortion of the recovered audio signal. The recovered audio level at the DEMOD output is 120 mV rms (25 kHz channel, 3 kHz deviation) or 60 mV rms (12.5 kHz channel, 1.5 kHz deviation). An additional RSSI output provides a DC voltage level that is proportional to RF signal level. This voltage is measured by an A/D converter contained in the microprocessor (PE4_AN4, U401 pin 63).

9.3 UHF Transmitter

The UHF transmitter covers the range of 438-470 MHz. Depending on model, the output power of the transmitter is either switchable on a per-channel basis between high power (4 watts) and low power (1 watt), or is factory preset to 2 watts. The transmitter is divided into four major blocks as shown in Figure 9-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control.

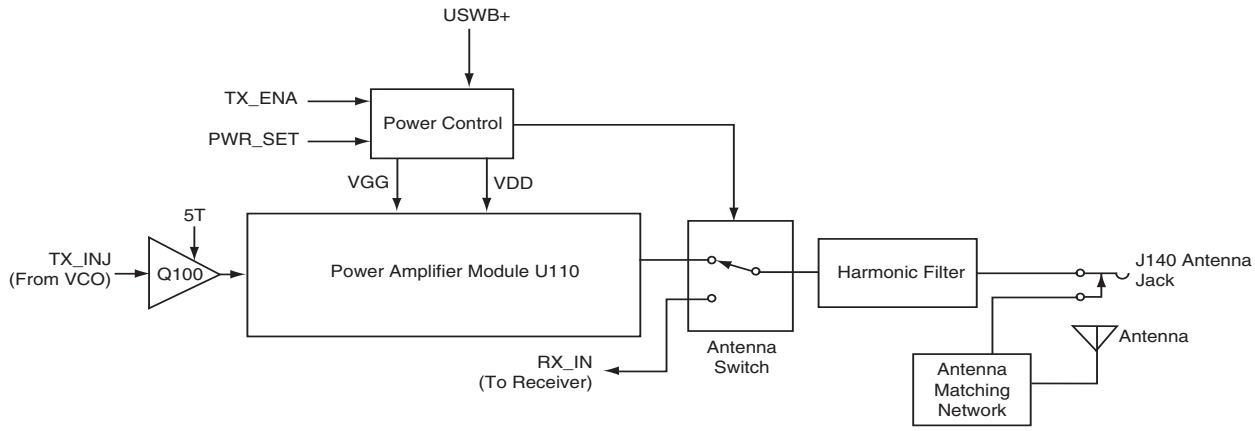

Figure 9-2. UHF Transmitter Block Diagram

9.3.1 Transmitter Power Amplifier

The transmitter power amplifier has three stages of amplification. The first stage, Q100, operates in Class A from the 5T source. It provides 17 dB of gain and an output of 50 mW. The current drain is typically 30mA. Components C105 and L103 match the output of Q100 to the 50Ω input of the module U110.

U110 is a two stage Silicon MOS FET power amplifier module. Drain voltage is obtained from UNSW B+ after being routed through current-sense resistor R150 in the power control circuit. The output power of the module is controlled by varying the DC gate bias on U110 pin 2 (VGG).

9.3.2 Antenna Switch

The antenna switch consists of two pin diodes, D120 and D121. In the receive mode, both diodes are off. Signals applied at the antenna or at jack J140 are routed, via the harmonic filter, through network C122-C124 and L121, to the receiver input. In the transmit mode, Q170 is on and TXB+ is present, forward-biasing both diodes into conduction. The diode current is 20 mA, set by R120-R121. The transmitter RF from U110 is routed through D120, and via the harmonic filter to the antenna jack. D121 conducts, shunting RF power and preventing it from reaching the receiver. L121 is selected to appear as a 1/4 wave at UHF, so that the low impedance of D121 appears as a high impedance at the junction of D120 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

9.3.3 Harmonic Filter

The harmonic filter consists of components C130-C136 and L130-L132. The harmonic filter is a seven-pole Chebychev low-pass configuration, optimized for low insertion loss, with a 3 dB frequency of approximately 600 MHz and typically less than 0.8 dB insertion loss in the passband.

9.3.4 Antenna Matching Network

The harmonic filter presents a 50Ω impedance to antenna jack J140. A matching network, made up of C140-C141 and L140, is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the impedance presented by the antenna, significantly improving the antenna's efficiency.

9.3.5 Power Control

The power control circuit is a dc-coupled amplifier whose output is the dc gate bias voltage (VGG) applied to the two stages of the RF power amplifier U110.

The output power of the transmitter is adjusted by varying the setting of the power-set DAC contained in the ASFICcmp IC (DACG, U451 pin 6). This PWR_SET voltage is applied to U150 pin 3.

Stage U150-2 compares the voltage drop across current sense resistor R150 to the voltage drop across resistor R151 caused by current flow through Q150, and adjusts its output (pin 7) to maintain equal voltages at pins 5 and 6. Thus the current flow through Q150, and hence its emitter voltage, is proportional to the current drawn by stage U110, which is in turn proportional to the transmitter output power. The emitter voltage of Q150 is applied to U150 pin 2, where it is compared to the power set voltage PWR_SET at pin 3.

The output of U150 pin 1 is divided by R110 and R111 and applied as a gate voltage to the power amplifier U110. By varying this gate voltage as needed to keep the voltages at U150 pins 2 and 3 equal, power is maintained at the desired setting. Excessive final current, for example due to antenna mismatch, causes a lowering of the voltage at U150 pin 6, an increased voltage at pin 2, and a lowering of the voltage at pin 1 and of the gate voltage VGG. This prevents damage to the final stage due to excessive current.

9.4 UHF Frequency Generation Circuitry

The frequency generation system, shown in Figure 9-3, is composed of two circuit blocks, the Fractional-N synthesizer IC U201, the VCO/Buffer IC U251, and associated circuitry. Figure 9-4 shows the peripheral interconnect and support circuitry used in the synthesizer block, and Figure 9-5 details the internal circuitry of the VCOBIC and its interconnections to the surrounding components. Refer to the schematic to identify reference designators.

The Fractional-N synthesizer is powered by regulated 5 V and 3 V provided by U310 and U330 respectively. 5 V is applied to U201 pins 13 and 30, and 3 V is applied to pins 5, 20, 34 and 36. The synthesizer in turn generates a super-filtered 4.5 V supply (VSF, from pin 28) to power U251. In addition to the VCO, the synthesizer also interfaces with the logic and ASFICcmp circuits. Programming for the synthesizer is accomplished through the microprocessor SPI_DATA_OUT,

SPI_CLK, and SYNTH_CS (chip select) lines (U409 pins 100, 1 and 47 respectively). A logic high (3 V) from U201 pin 4 indicates to the microprocessor that the synthesizer is locked.

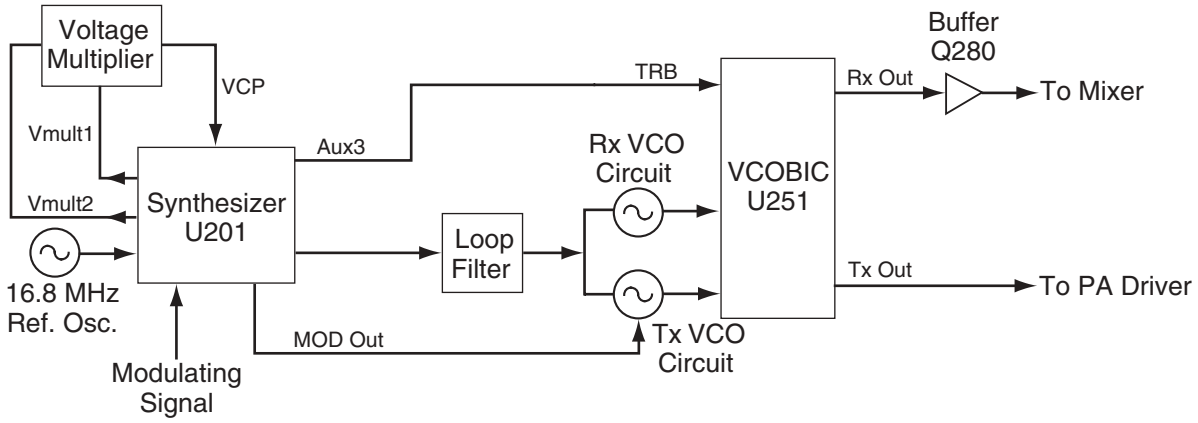

Figure 9-3. UHF Frequency Generation Unit Block Diagram

Transmit modulation from the ASFICcmp (U451 pin 40) is applied to U201 pin 10 (MOD_IN). An electronic attenuator in the ASFICcmp adjusts overall transmitter deviation by varying the audio level applied to the synthesizer IC. Internally the audio is digitized by the Fractional-N synthesizer and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for the purpose of balancing the low port and high port modulation and reducing the deviation by 6 dB for 12.5 kHz channels, and is available at U201 pin 41 (VCO_MOD). This audio signal is routed to the VCO's modulator.

9.4.1 Fractional-N Synthesizer

The Fractional-N synthesizer, shown in Figure 9-4, uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-C203, R202 and D201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor D201 from U201 pin 25 is determined by a temperature-compensation algorithm within U201, and is specific to each crystal Y201, based on a unique code assigned to the crystal that identifies its temperature characteristics. Stability is better than 2.5 ppm over temperatures of -30 to 60°C. Software-programmable electronic frequency adjustment is achieved by an internal DAC which provides a frequency adjustment voltage from U201 pin 25 to varactor D201.

The synthesizer IC U201 further divides the 16.8 MHz signal to 2.1 MHz, 2.225 MHz, or 2.4 MHz for use as reference frequencies. It also provides a buffered 16.8 MHz signal at U201 pin 19 for use by the ASFICcmp.

To achieve fast locking of the synthesizer, an internal adapt charge pump provides higher current at U201 pin 45 to quickly force the synthesizer within lock range. The required frequency is then locked by the normal mode charge pump at pin 43. A loop filter (C243-C245 and R243-R245) removes noise and spurs from the steering voltage applied to the VCO varactors, with additional filtering located in the VCO circuit.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C221-C224 and D220-D221. Two 3 V square waves from U201 pins 14-15 provide the drive signals for the voltage multiplier, which generates 12.1 V at U201 pin 47. This voltage is filtered by C225-C228.

One of the auxiliary outputs of the synthesizer IC (AUX3, U201 pin 2) provides the TRB signal which determines the operating mode of the VCO, either receive or transmit.

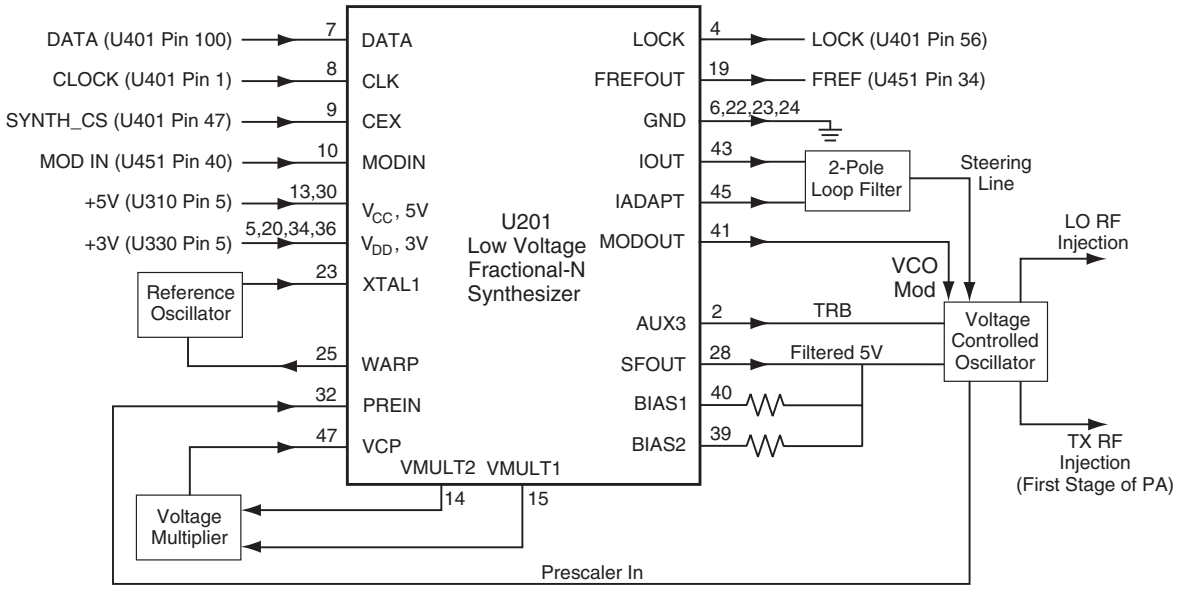

Figure 9-4. UHF Synthesizer Block Diagram

9.4.2 Voltage Controlled Oscillator (VCO)

The VCOBIC (U251), shown in Figure 9-5, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U251 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U251 pin 12 through a low pass filter, to the prescaler input of the synthesizer IC (U201 pin 32). After frequency comparison in the synthesizer, a resultant DC control voltage is used to steer the VCO frequency. When the PLL is locked on frequency, this voltage can vary between 3.5 V and 10 V. L251 and C252 further attenuate noise and spurs on the steering line voltage.

In the receive mode, the TRB line (U251 pin 19) is low. This activates the receive VCO and the receive buffer of U251, which operate within the range of 393.15 to 425.15 MHz. The VCO frequency is determined by tank inductor L254, C253-C257, and varactor D251. The buffered RF signal at U251 pin 8 is further amplified by Q280 and applied as RX_INJ to the low-pass injection filter in the receiver front end circuit.

In the transmit mode, U251-19 is driven high by U201 pin 2, enabling the transmit VCO and buffer. The 438-470 MHz RF signal from U251 pin 10 is applied as TX_INJ to the input of the transmitter circuit via matching network C290-C291 and L291. TX VCO frequency is determined by L264, C263-

C267, and varactor D261. High-port audio modulation from the synthesizer IC is applied as VCO_MOD to varactor D262 which modulates the transmit VCO.

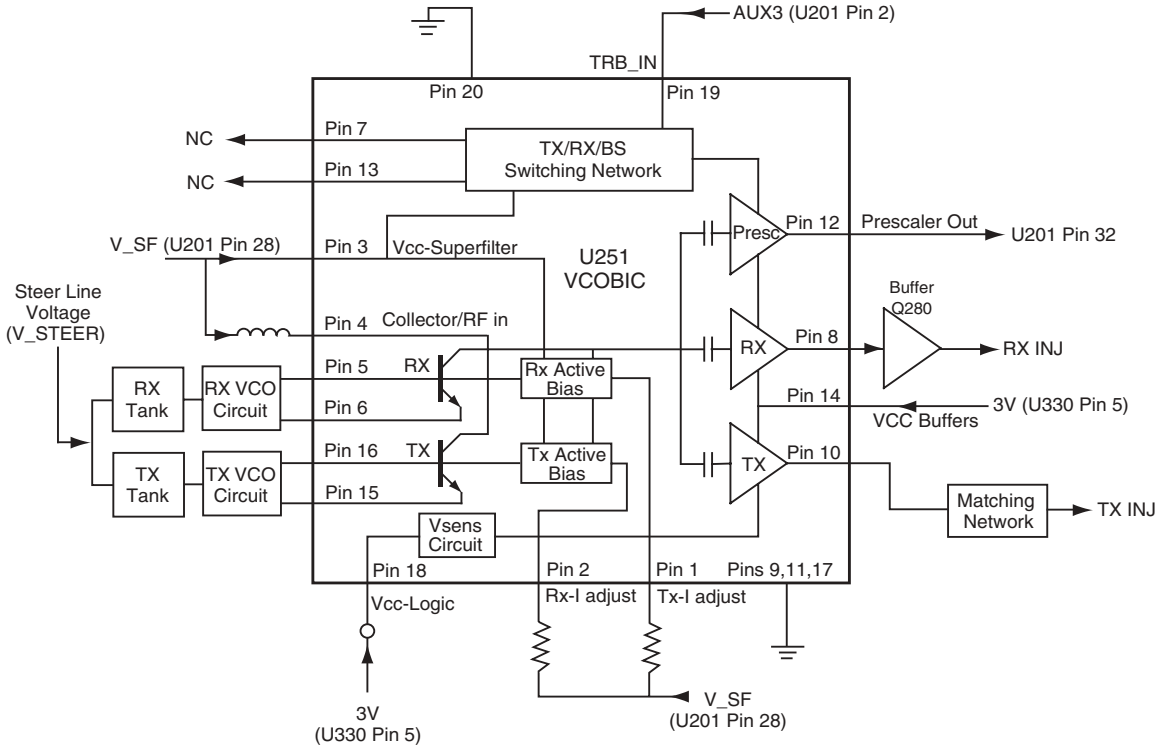

Figure 9-5. UHF VCO Block Diagram

Notes:

Chapter 10 465-495 MHz UHF Theory Of Operation

10.1 Introduction

This chapter provides a detailed theory of operation for the radio components. Schematic diagrams for the circuits described in the following paragraphs are located in Chapter 12 of this manual.

10.2 UHF Receiver

The UHF receiver covers the range of 465-495 MHz and provides switchable IF bandwidth for use with 20/25/30 kHz or 12.5 kHz channel spacing systems. The receiver is divided into two major blocks, as shown in Figure 10-1.

- Front End
- Back End

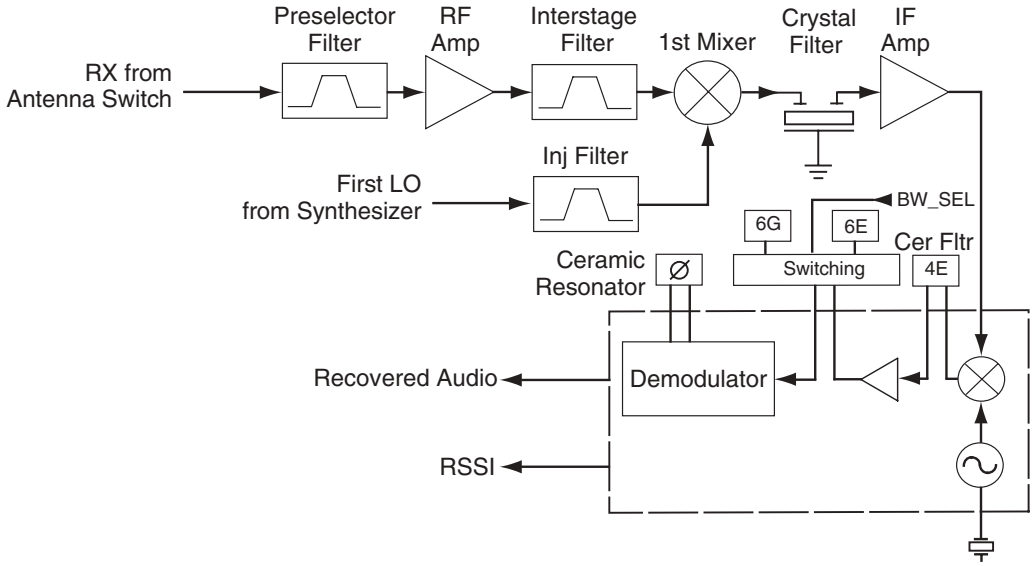

Figure 10-1. UHF Receiver Block Diagram

10.2.1 Receiver Front End

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, an interstage filter, and a double-balanced first mixer.

The preselector filter is a fixed-tuned 3-pole Butterworth design using discrete elements (L1-L3, C1-C10, C12 and C523) in a shunt-resonator configuration. It has a 3 dB bandwidth of 68 MHz centered at 480 MHz, an insertion loss of 2 dB and image attenuation of 39 dB at 405.3 MHz. Diode CR1 protects the RF amplifier by limiting excessive RF levels. The filter bandwidth is considerably wider than the receive band, to achieve low insertion loss in a compact size. C523 provides a transmission-zero to improve image attenuation.

The output of the filter is matched to the base of RF amplifier Q21, which provides 18 dB of gain and a noise figure of 3.3 dB. A BFS505 device is used for high gain, low noise figure and reduced operating current. Operating voltage is obtained from the 5R source, which is turned off during transmit to reduce dissipation in Q21. Current mirror Q22 maintains the operating current of Q21 constant at 8 mA regardless of device and temperature variations, for optimum dynamic range and noise figure.

The output of the RF amplifier is applied to the interstage filter, a fixed-tuned 4-pole Butterworth shunt-coupled resonator design having a 3 dB bandwidth of 68 MHz centered at 480 MHz, and insertion loss of 3.3 dB. This filter yields an image rejection of 55 dB at 405.3 MHz, assisted by a transmission-zero at 300 MHz implemented by C524 for the reasons mentioned above.

The output of the interstage filter is connected to the passive double-balanced mixer consisting of components T41, T42, and CR41. This mixer has a conversion loss of 7.2 dB. Low-side injection from the frequency synthesizer is filtered by L40-L41 and C41-C45 to remove second harmonic energy that may degrade half-IF spurious rejection performance. The injection filter has a 3 dB bandwidth of 100 MHz centered at 408 MHz, and an insertion loss of 2.5 dB. The second-harmonic rejection is typically 40 dB or greater. The filtered injection signal is applied to T42 at a level of +6 dBm.

The mixer output is applied to a diplexer network (L51-L52, C51, R51) which matches the 44.85 MHz IF signal to crystal filter FL51, and terminates the mixer into 50Ω at all other frequencies.

10.2.2 Receiver Back End

The receiver back end is a dual conversion design. High IF selectivity is provided by FL51, a 4-pole fundamental mode 44.85 MHz crystal filter with a minimum 3 dB bandwidth of ±6.7 kHz, a maximum 20 dB bandwidth of + 12.5 kHz, and a maximum insertion loss of 3.5 dB. The output is matched to IF amplifier stage Q51 by L53 and C93. Q51 provides 16 dB of gain and a noise figure of 1.8 dB. The dc operating current is 1 mA. The output of Q51 is applied to the input of the receiver IFIC U51. Diode CR51 limits the maximum RF level applied to the IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio and RSSI op amps. The second LO frequency, 44.395 MHz, is determined by Y51. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters, FL52 (between the second mixer and IF amp) and FL53 or FL54 (between the IF amp and the limiter input). The wider filter FL53 is used for 20/25 kHz channel spacing, and the narrower filter FL54 is used for 12.5 kHz channels. When the BW_SEL line is high, the two upper diodes in packages D51 and D52 are forward biased, selecting FL53 for 20/25 kHz channels. When the BW_SEL line is low, the two lower diodes in packages D51 and D52 are forward biased, selecting FL54 for 12.5 kHz channels.

The ceramic filters have the following specifications:

	FL52	**FL53**	**FL54**
Number of Elements:	4	6	6
Insertion Loss:	4 dB	4 dB	4 dB
6 dB Bandwidth:	15 kHz	15 kHz	9 kHz
50 dB Bandwidth:	30 kHz	30 kHz	22 kHz
Stopband Rejection:	27 dB	47 dB	47 dB

Ceramic resonator Y70 provides phase vs. frequency characteristic required by the quadrature detector, with 90 degree phase shift occurring at 455 kHz. Buffer Q70 provides a lower driving impedance from the limiter to the resonator, improving the IF waveform and lowering the distortion of the recovered audio signal. The recovered audio level at the DEMOD output is 120 mV rms (25 kHz channel, 3 kHz deviation) or 60 mV rms (12.5 kHz channel, 1.5 kHz deviation). An additional RSSI output provides a DC voltage level that is proportional to RF signal level. This voltage is measured by an A/D converter contained in the microprocessor (PE4_AN4, U401 pin 63).

10.3 UHF Transmitter

The UHF transmitter covers the range of 465-495 MHz. Depending on model, the output power of the transmitter is either switchable on a per-channel basis between high power (4 watts) and low power (1 watt), or is factory preset to 2 watts. The transmitter is divided into four major blocks as shown in Figure 10-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control.

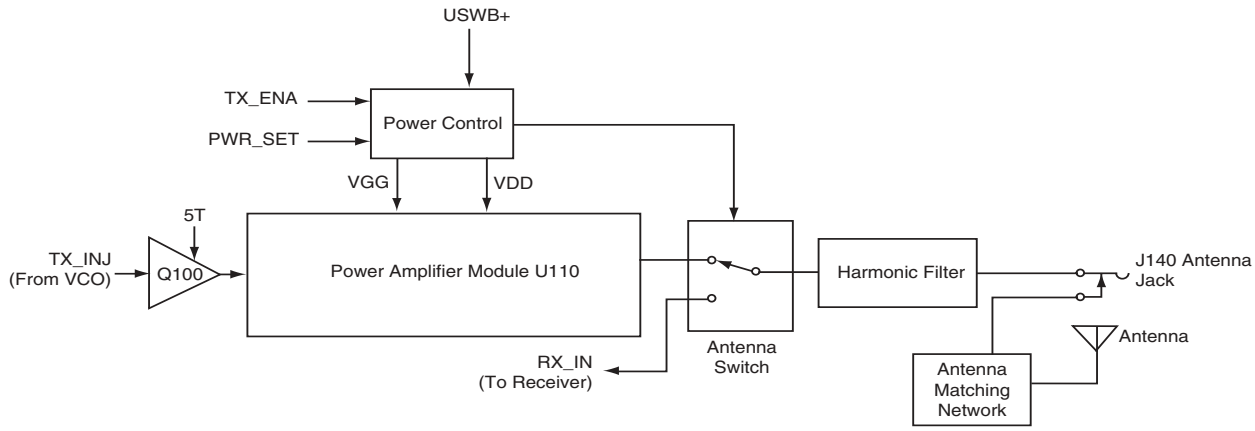

Figure 10-2. UHF Transmitter Block Diagram

10.3.1 Transmitter Power Amplifier

The transmitter power amplifier has three stages of amplification. The first stage, Q100, operates in Class A from the 5T source. It provides 17 dB of gain and an output of 50 mW. The current drain is typically 30mA. Components C105 and L103 match the output of Q100 to the 50Ω input of the module U110.

U110 is a two stage Silicon MOS FET power amplifier module. Drain voltage is obtained from UNSW B+ after being routed through current-sense resistor R150 in the power control circuit. The output power of the module is controlled by varying the DC gate bias on U110 pin 2 (VGG).

10.3.2 Antenna Switch

The antenna switch consists of two pin diodes, D120 and D121. In the receive mode, both diodes are off. Signals applied at the antenna or at jack J140 are routed, via the harmonic filter, through network C122-C124 and L121, to the receiver input. In the transmit mode, Q170 is on and TXB+ is present, forward-biasing both diodes into conduction. The diode current is 20 mA, set by R120-R121. The transmitter RF from U110 is routed through D120, and via the harmonic filter to the antenna jack. D121 conducts, shunting RF power and preventing it from reaching the receiver. L121 is selected to appear as a 1/4 wave at UHF, so that the low impedance of D121 appears as a high impedance at the junction of D120 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

10.3.3 Harmonic Filter

The harmonic filter consists of components C130-C136 and L130-L132. The harmonic filter is a seven-pole Chebychev low-pass configuration, optimized for low insertion loss, with a 3 dB frequency of approximately 655 MHz and typically less than 0.8 dB insertion loss in the passband.

10.3.4 Antenna Matching Network

The harmonic filter presents a 50Ω impedance to antenna jack J140. A matching network, made up of C140-C141 and L140, is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the impedance presented by the antenna, significantly improving the antenna's efficiency.

10.3.5 Power Control

The power control circuit is a dc-coupled amplifier whose output is the dc gate bias voltage (VGG) applied to the two stages of the RF power amplifier U110.

The output power of the transmitter is adjusted by varying the setting of the power-set DAC contained in the ASFICcmp IC (DACG, U451 pin 6). This PWR_SET voltage is applied to U150 pin 3.

Stage U150-2 compares the voltage drop across current sense resistor R150 to the voltage drop across resistor R151 caused by current flow through Q150, and adjusts its output (pin 7) to maintain equal voltages at pins 5 and 6. Thus the current flow through Q150, and hence its emitter voltage, is proportional to the current drawn by stage U110, which is in turn proportional to the transmitter output power. The emitter voltage of Q150 is applied to U150 pin 2, where it is compared to the power set voltage PWR_SET at pin 3.

The output of U150 pin 1 is divided by R110 and R111 and applied as a gate voltage to the power amplifier U110. By varying this gate voltage as needed to keep the voltages at U150 pins 2 and 3 equal, power is maintained at the desired setting. Excessive final current, for example due to antenna mismatch, causes a lowering of the voltage at U150 pin 6, an increased voltage at pin 2, and a lowering of the voltage at pin 1 and of the gate voltage VGG. This prevents damage to the final stage due to excessive current.

10.4 UHF Frequency Generation Circuitry

The frequency generation system, shown in Figure 10-3, is composed of two circuit blocks, the Fractional-N synthesizer IC U201, the VCO/Buffer IC U251, and associated circuitry. Figure 10-4 shows the peripheral interconnect and support circuitry used in the synthesizer block, and Figure 10-5 details the internal circuitry of the VCOBIC and its interconnections to the surrounding components. Refer to the schematic to identify reference designators.

The Fractional-N synthesizer is powered by regulated 5 V and 3 V provided by U310 and U330 respectively. 5 V is applied to U201 pins 13 and 30, and 3 V is applied to pins 5, 20, 34 and 36. The synthesizer in turn generates a super-filtered 4.5 V supply (VSF, from pin 28) to power U251. In addition to the VCO, the synthesizer also interfaces with the logic and ASFICcmp circuits. Programming for the synthesizer is accomplished through the microprocessor SPI_DATA_OUT,

SPI_CLK, and SYNTH_CS (chip select) lines (U409 pins 100, 1 and 47 respectively). A logic high (3 V) from U201 pin 4 indicates to the microprocessor that the synthesizer is locked.

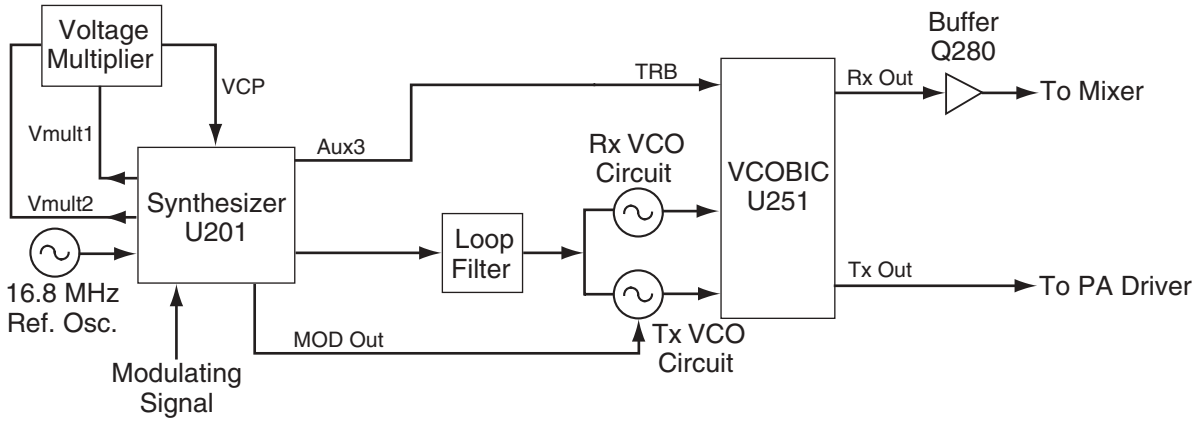

Figure 10-3. UHF Frequency Generation Unit Block Diagram

Transmit modulation from the ASFICcmp (U451 pin 40) is applied to U201 pin 10 (MOD_IN). An electronic attenuator in the ASFICcmp adjusts overall transmitter deviation by varying the audio level applied to the synthesizer IC. Internally the audio is digitized by the Fractional-N synthesizer and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for the purpose of balancing the low port and high port modulation and reducing the deviation by 6 dB for 12.5 kHz channels, and is available at U201 pin 41 (VCO_MOD). This audio signal is routed to the VCO's modulator.

10.4.1 Fractional-N Synthesizer

The Fractional-N synthesizer, shown in Figure 10-4, uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-C203, R202 and D201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor D201 from U201 pin 25 is determined by a temperature-compensation algorithm within U201, and is specific to each crystal Y201, based on a unique code assigned to the crystal that identifies its temperature characteristics. Stability is better than 2.5 ppm over temperatures of -30 to 60°C. Software-programmable electronic frequency adjustment is achieved by an internal DAC which provides a frequency adjustment voltage from U201 pin 25 to varactor D201.

The synthesizer IC U201 further divides the 16.8 MHz signal to 2.1 MHz, 2.225 MHz, or 2.4 MHz for use as reference frequencies. It also provides a buffered 16.8 MHz signal at U201 pin 19 for use by the ASFICcmp.

To achieve fast locking of the synthesizer, an internal adapt charge pump provides higher current at U201 pin 45 to quickly force the synthesizer within lock range. The required frequency is then locked by the normal mode charge pump at pin 43. A loop filter (C243-C245 and R243-R245) removes noise and spurs from the steering voltage applied to the VCO varactors, with additional filtering located in the VCO circuit.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C221-C224 and D220-D221. Two 3 V square waves from U201 pins 14-15 provide the drive signals for the voltage multiplier, which generates 12.1 V at U201 pin 47. This voltage is filtered by C225-C228.

One of the auxiliary outputs of the synthesizer IC (AUX3, U201 pin 2) provides the TRB signal which determines the operating mode of the VCO, either receive or transmit.

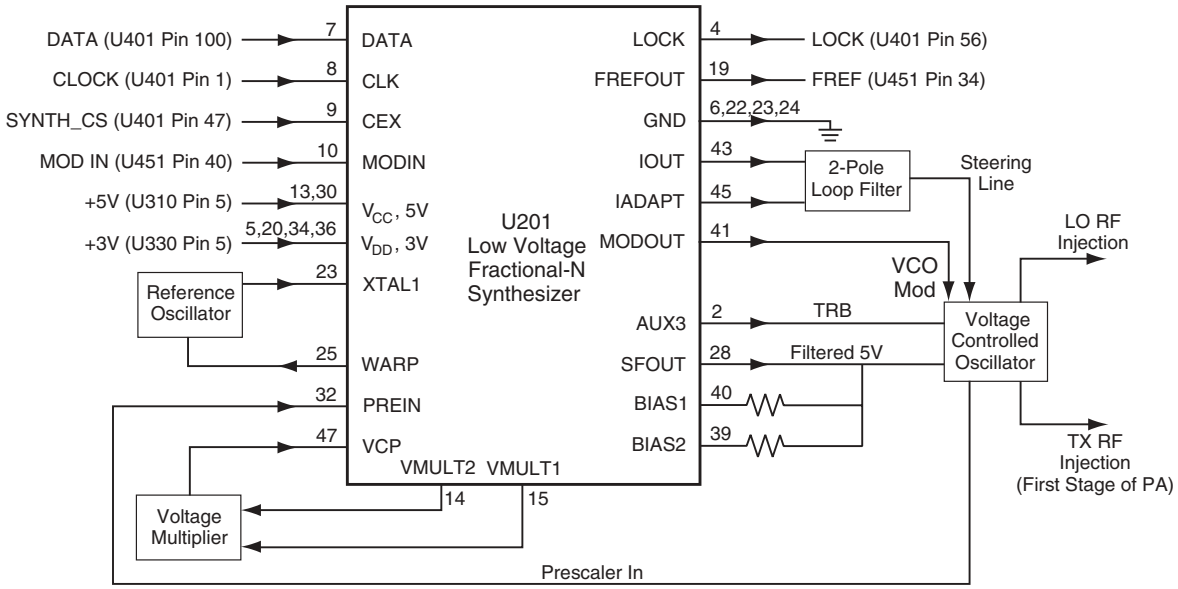

Figure 10-4. UHF Synthesizer Block Diagram

10.4.2 Voltage Controlled Oscillator (VCO)

The VCOBIC (U251), shown in Figure 10-5, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U251 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U251 pin 12 through a low pass filter, to the prescaler input of the synthesizer IC (U201 pin 32). After frequency comparison in the synthesizer, a resultant DC control voltage is used to steer the VCO frequency. When the PLL is locked on frequency, this voltage can vary between 3.5 V and 10 V. L251 and C252 further attenuate noise and spurs on the steering line voltage.

In the receive mode, the TRB line (U251 pin 19) is low. This activates the receive VCO and the receive buffer of U251, which operate within the range of 420.15 to 450.15 MHz. The VCO frequency is determined by tank inductor L254, C253-C257, and varactor D251. The buffered RF signal at U251 pin 8 is further amplified by Q280 and applied as RX_INJ to the low-pass injection filter in the receiver front end circuit.

In the transmit mode, U251-19 is driven high by U201 pin 2, enabling the transmit VCO and buffer. The 465-495 MHz RF signal from U251 pin 10 is applied as TX_INJ to the input of the transmitter circuit via matching network C290-C291 and L291. TX VCO frequency is determined by L264, C263-

C267, and varactor D261. High-port audio modulation from the synthesizer IC is applied as VCO_MOD to varactor D262 which modulates the transmit VCO.

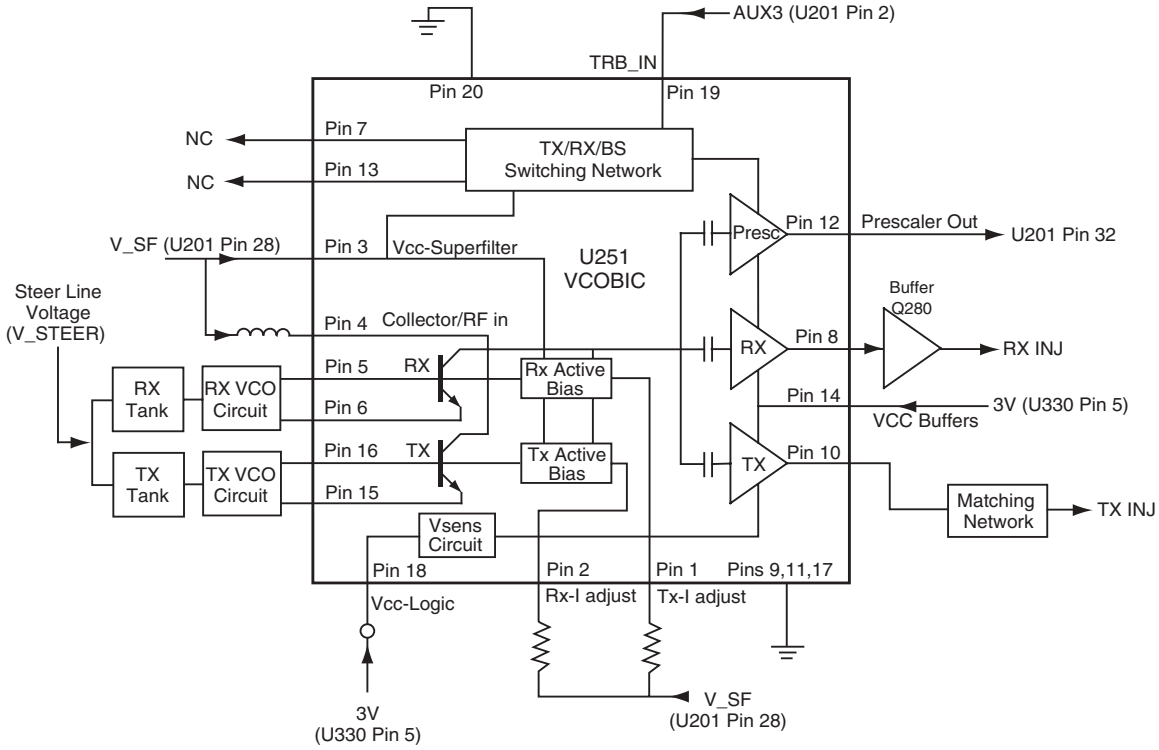

Figure 10-5. UHF VCO Block Diagram

Notes:

Chapter 11 UHF Troubleshooting Tables

11.1 Troubleshooting Table for Receiver

Table 11-1. Troubleshooting Table for Receiver

Symptom	Possible Causes	Procedure	Corrective Action
Radio Dead (no turn-on beep, no LED indication)	1. Battery dead or defective.	Substitute known good battery or battery eliminator.	Charge or replace battery.
	2. Defective batery contacts.	Inspect battery contacts for corrosion or bent terminals.	Clean/repair/replace J301.
	3. Blown fuse	Check voltage on each side of fuse. If blown, 0 VDC after fuse.	Check for short on output, check D301, VR301, troubleshoot/repair as needed, replace fuse.
	4. DC switching fault	Verify battery voltage present at S444 pin 5 when radio is on. Verify Q494-1 is at least 1V dc, Q494-6 is ~0.1V dc, Q493-3 is at Vbatt.	Check/replace on-off-volume control S444. Troubleshoot/replace Q493/4.
	5. Microprocessor not starting up.	Verify clock input to U401-90 (EXTAL) is 7.3975 MHz using high impedance probe. If clock is 3.8MHz, check for shorts on U401 pins. Connect RIB to verify communication via CPS. Verify U401-94 (RESET) is high.	Verify 16.8 MHz signal at U451-34. If OK, troubleshoot/replace U451. If not present, troubleshoot U201 Synthesizer. Reprogram/reflash as needed. If RESET is Low, troubleshoot regulator U320. Check for shorts at U401 pins. Replace U401 (depot only). Reprogram/reflash as needed.
	6. Regulator fault	Verify U310-5 is 5V dc, U320-5 is 3.3V dc, U330-5 is 3V dc.	Check for shorts on outputs, troubleshoot/repair as needed, replace faulty regulator.

Table 11-1. Troubleshooting Table for Receiver (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
No Audio	1. Synthesizer out of lock	Verify U201-4 is at 3V dc.	Troubleshoot synthesizer/VCO circuits.
	2. Defective IFIC	Verify audio is present at U51-8.	Check Q70, Y70, U51.
	3. RX audio buffer fault	Verify audio is present at U451-2.	Check U510 and associated parts.
	4. ASFIC fault	Verify audio is present at U451-41. Verify U451-14 is high.	Check squelch setting, PL/DPL programming. Troubleshoot/ replace U451.
	5. Audio PA fault	Verify U490-1 is <0.2V dc. Verify audio is present at U490-5 and 8.	Check Q490. Check/replace U490.
	6. Defective speaker	Verify audio is present at speaker terminals.	If not, check continuity of J471-2 and 3. Check J491. If yes, replace speaker.
No Receive (squelch noise present)	1. No first injection	Check that RF level at T42-6 is approx +6 dBm. Check that RF level at U251-8 is at least -8 dBm.	Check injection filter C40-44, L40-41. If yes, check Q280 and associated parts. If no, check U251 and components on pins 5 and 6.
	2. No 5R source.	Verify U401-49 is high in RX. Verify Q311 gate is 0V dc in RX Verify Q311 drain is 5V dc in RX.	Check/replace U401 Check/replace Q313. Check for shorts, check/replace Q311.
	3. Harmonic filter or antenna switch fault	Apply on-channel 100 mV RF signal at antenna port. Verify RF level at jct. C1/C2 per schematic.	Check TX harmonic filter, D120-121. Should be 0V dc on D120-121.
	4. Back end fault	Apply on-channel 100 mV RF signal at antenna port. Measure RF levels from FL51 through U51.	Check components prior to loss-of-signal point.
	5. No second injection	Measure RF level at U51-3, verify approx. 280 mV rms.	If dc voltages at U51-3 and 4 are OK, check Y51 and associated parts. If not replace U51.

11.2 Troubleshooting Table for Synthesizer

Table 11-2. Troubleshooting Table for Synthesizer

Symptom	Possible Causes	Procedure	Corrective Action
Synthesizer Out of Lock (RX mode only)	1. VCO fault	Verify oscillator is working, check RF level at U251-10 per schematic. Check dc voltages at U251 pin 2 through 6 and 10 per Table 11-4. Verify steering line voltage is between ~3V and 10V.	Check VCO tank components connected to U251-5 and 6. Check for shorts/opens, replace U251. Check D251 and associated components.
	2. Synthesizer fault	Verify TRB line (from U201-2 to U251-19) is low in RX mode	Check for shorts, check U201 voltages per Table 11-4, replace U201 if incorrect.
	3. Programming fault	Verify RX channel programming is correct.	Re-program if necessary.
Synthesizer Out of Lock (TX mode only)	1. VCO fault	Verify oscillator is working, check RF level at U251-10 per schematic. Check dc voltages at U251 pins 1,3,4,10,15,16 per Table 11-4. Verify steering line voltage is between ~3V and 10V.	Check VCO tank components connected to U251-15 and 16. Check for shorts/opens, replace U251. Check D261 and associated components.
	2. Synthesizer fault	Verify TRB line (U201-2 to U251-19) is high (3V) in TX mode	Check for shorts, check U201 voltages per Table 11-4, replace U201 if incorrect.
	3. Programming fault	Verify TX channel programming is correct.	Re-program if necessary.
Synthesizer Out of Lock (RX and TX modes)	1. VCO fault	Check that RF level at U251-12 is at least 150 mV (VHF) or -12 to -20 dBm (UHF)	If low/missing, check L276, C276-7, R276.
	2. Synthesizer fault	Check that RF level at U201-32 is at least 150 mV (VHF) or -12 to -20 dBm (UHF). Verify steering line voltage is between ~3V and 10V.	If correct, check/replace U201. If incorrect, check R248 and C241. Check loop filter components R243-5 and C243-5.
	3. DC voltage fault	Verify 4.5V dc at U201-28. Verify 12.1V dc at U201-47	Check C231-233, etc., for shorts. If OK check/replace U201. Check for 3V 1.05 MHz sq waves at U201-14 and 15. Check C218-228, D220-221.
	4. Programming fault	Verify channel programming is correct.	Re-program if necessary.

11.3 Troubleshooting Table for Transmitter

Table 11-3. Troubleshooting Table for Transmitter

Symptom	Possible Causes	Procedure	Corrective Action
No Transmit (no TX LED indication)	1. PTT switch defective.	Verify U401-71 goes low when PTT is pressed.	Replace PTT switch S441.
	2. EXT MIC PTT fault	Verify U401-72 goes low when J471-4 is grounded.	Check/replace Q470, L471 etc.
No Transmit (TX LED indication OK)	1. Synthesizer out of lock	Refer to Table 11-2.	Refer to Table 11-2.
	2. No TX_ENABLE	Verify U401-50 is high when pin 71 or 72 is low.	Check/replace U401.
	3. TX DC switch fault	Verify Q171-C is 0V in TX. Verify Q170-C is at Vbatt in TX.	Replace Q171. Check for shorts, replace Q170.
	4. Power control fault	Check Q150 and U150 dc voltages per schematic and Table 11-4.	Repair/replace defective components
	5. No TX injection	Check that RF level at jct. R100/R101 per schematic.	Check U251, L291-292, C290-291.
	6. No 5T source	Verify Q312 gate is 0V dc in TX Verify Q312 drain is 5V dc in TX.	Check/replace Q313. Check for shorts, check/replace Q312.
	7. TX gain stage failure	Check RF levels at Q100 and U110 per schematic.	Troubleshoot Q100/U110 and associated circuitry.
	8. Antenna switch failure	Verify dc voltage at jct. R122/L120 is approx 1.5V.	Check/replace D120-121, L120-121, R120-122, etc.
Low Power	1. Low TX injection	Check that RF level at jct. R100/R101 per schematic.	Check U251, L291-292, C290-291.
	2. Low gain in TX stage	Verify dc voltage at Q100-E is ~1.3V (VHF) or ~0.5V (UHF). Verify that RF level at U110-1 is approx. 1V (VHF) or 1.6V (UHF).	Verify 5T voltage is correct. Troubleshoot Q100 circuitry. Troubleshoot Q100 circuitry. Check/replace Q100.
	3. Incorrect control voltage	Verify that the dc voltage at PWR_SET (R162) is approx 1.8V dc (at 1 watt) to 2.6V dc (at 4-5 watts). Verify that the dc voltage at U110-2 is approx 2-3V dc (at 1 watt) to 3-4V dc (at 4-5 watts). (See schematic.)	Check programming. Troubleshoot controller circuitry. Check/replace U451. Troubleshoot U150, Q150 and associated circuitry.
	4. Antenna switch defect	Verify dc voltage at jct. R122/L120 (VHF) or R121/L120 (UHF) is approx 1.7V. *Note: Do not attempt to measure RF or DC voltages at the diodes. Damage to test equipment may occur.*	Check/replace D120-121, L120-121, R120-122, etc.
	5. Harmonic filter defect	Visually inspect components C130-137, L130-132. Check dc continuity of L130-132 *in RX mode only.*	Repair/replace if necessary.

Table 11-3. Troubleshooting Table for Transmitter (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
Poor TX range, conducted power OK	1. RF test jack defective	Verify continuity of J140 pins 3 and 4 *in RX mode only.*	Replace J140.
	2. Antenna matching network fault	Visually inspect components C140-141, L140 or L141. Check dc continuity of L140 or L141*in RX mode only.*	Repair/replace if necessary.
	3. Defective or wrong antenna	Verify correct antenna is installed. Try another antenna.	Replace antenna.
No internal mic audio (EXT MIC audio OK)	1. Mic bias fault	Verify U451-35 is low when side PTT is pressed. Verify Q470-6 is high when side PTT button is pressed.	Check/replace U451. Check/replace R474, R476, and Q470.
	2. Defective mic	Verify approx 1.8V dc across cartridge when side PTT button is pressed. Verify audio present (~10 mV rms) when speaking into mic.	Check mic connector and R478. Replace mic cartridge.
	3. Defective mic jack	Verify continuity between J471 pins 4 and 5.	Replace J471.
No EXT MIC audio	1. Mic bias fault	Verify approx 1.8V dc across EXT MIC cartridge in TX mode. Verify audio present (~10 mV rms) when speaking into mic.	Check Q470. R475, R477, L471. Check VR473, VR475, D470 for shorts.
	2. Audio path fault	Verify mic audio present (~10 mV rms) at U451-46. Verify amplified mic audio present (~200 mV rms) at U451-40.	Check L471, C470. Check/replace U451.
	3. Defective audio accessory	Try another accessory.	Replace defective accessory.

11.4 Troubleshooting Table for Board and IC Signals

Table 11-4. Troubleshooting Table for Board and IC Signals

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U51 IFIC	1	RF input 44.85 MHz	1.20	
	2	RF input decoupling	1.20	
	3	2nd LO osc output	4.02	
	4	2nd LO osc input	4.60	
	5	RSSI output	0.74	(no received signal)
	6	Vcc	4.70	
	7	Audio feedback	0.89	
	8	Audio output	1.44	DEMOD to stage U510
	9	RSSI feedback	0.74	(no received signal)
	10	Quad detector input	2.22	
	11	Limiter output	1.25	
	12	Limiter decoupling 2	1.30	
	13	Limiter decoupling 1	1.30	
	14	Limiter input	1.28	
	15	Ground	GND	
	16	IF amp output	1.22	
	17	IF amp decoupling 2	1.26	
	18	IF amp input	1.26	
	19	IF amp decoupling 1	1.26	
	20	2nd mixer output	3.09	
U52 BW Select Switch	1	Inverter 1 input	0	(25 kHz mode)
	2	Inverter 2 output	0	(25 kHz mode)
	3	Inverter 3 input (NU)	GND	
	4	Ground	GND	
	5	Inverter 3 output (NU)	4.96	
	6	Inverter 2 input	3.00	(25 kHz mode)
	7	Inverter 1 output	4.95	(25 kHz mode)
	8	Vcc	4.96	

Table 11-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U110 RF Power Amp	1	RF input	0	(TX mode)
	2	Vgg (gate bias)	2.65 (typ)	(TX mode) (4.25V typ at VHF)
	3	Vdd	6.59	(TX mode)
	4	RF output	--	Do not measure
	5	Ground	GND	
U150 Dual Opamp	1	Unit 1 output	4.20 (typ)	(TX mode) (5.8V typ at VHF)
	2	Unit 1 (-) input	2.39 (typ)	(TX mode)
	3	Unit 1 (+) input	2.39 (typ)	(TX mode)
	4	Ground	GND	
	5	Unit 2 (+) input	3.30 (typ)	(TX mode)
	6	Unit 2 (-) input	3.35 (typ)	(TX mode)
	7	Unit 2 output	2.23 (typ)	(TX mode)
	8	Vcc	6.79	(TX mode)
U201 Freq Synthesizer	1	AUX2 output (NU)	0	
	2	AUX3 output (TRB)	0.03	To U251-19 (RX mode)
	3	AUX4 output (NU)	0	
	4	Lock detect output	2.98	To U401-56
	5	PD Vdd	2.98	
	6	Digital ground	GND	
	7	Serial data input	3.23	
	8	Serial clock input	0	
	9	Synth chip select	3.23	From U401-47
	10	Modulation input	1.50	From U451-40
	11	VMULT4 (NU)	2.98	
	12	VMULT3 (NU)	0	
	13	VRO	4.96	
	14	VMULT2	1.49	
	15	VMULT1	1.49	
	16	INDMULT (NU)	0	
	17	NC1	0	
	18	Ref select (NU)	0	
	19	Buffered 16.8 MHz out	1.54	
	20	Analog Vdd	3.00	
	21	V bypass (NU)	1.55	
	22	Analog ground	GND	
	23	Ref osc XTAL1	2.07	

Table 11-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U201 Freq Synthesizer	24	Ref osc XTAL2	0	
	25	Ref osc warp output	3.00	
	26	Superfilter cap	4.48	
	27	Superfilter base (NU)	3.76	
	28	Superfilter output	4.52	
	29	NC2	0	
	30	Superfilter input	4.96	
	31	NC3	0	
	32	Prescaler input	1.97	
	33	Prescaler ground	GND	
	34	Prescaler Vdd	2.99	
	35	Prescaler Vref (NU)	1.97	
	36	Digital Vdd	2.99	
	37	TEST1 (NU)	0.01	
	38	TEST2 (NU)	0	
	39	Bias 2	3.38 (typ)	(1.34V in TX mode)
	40	Bias 1	1.50 (typ)	(3.20V in TX mode)
	41	Modulation output	3.42 (typ)	(1.62V typ in TX mode)
	42	CCOMP (NU)	0.05	
	43	Steering line IOUT	9.62 (typ)	Depends on frequency
	44	PD ground	GND	
	45	Steering line IADAPT	9.62 (typ)	Depends on frequency
	46	Adapt switch (NU)	0	
	47	Voltage from charge pump	12.8	
	48	AUX1 output (NU)	2.98	
U251 VCO / Buffer	1	TX VCO current adjust	4.50	
	2	RX VCO current adjust	4.35	
	3	Superfiltered input	4.51	
	4	Collector RF in amp	4.35	
	5	RX VCO base	1.27	
	6	RX VCO emitter	0.48	
	7	RX switch output (NU)	0	
	8	RX buffered VCO output	3.36	
	9	GND_FLAG	GND	
	10	TX buffered VCO output	3.36	
	11	GND_BUFFERS	GND	

Table 11-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U251 VCO / Buffer	12	Prescaler output	2.26	
	13	TX switch output (NU)	0.06	
	14	Vcc_BUFFERS	3.00	
	15	TX VCO emitter	0	(RX mode)
	16	TX VCO base	0	(RX mode)
	17	GND_LOGIC	GND	
	18	Vcc_LOGIC	3.00	
	19	TRB input	0.03	From U201-2 (RX mode)
	20	FLIP input	GND	
U310 5V Regulator	1	Vin	7.48	
	2	Ground	GND	
	3	Control input	7.48	
	4	Bypass capacitor	1.26	
	5	Vout	4.96	
U320 3.3V Regulator	1	Ground	GND	
	2	Feedback	1.23	
	3	Tap (NU)	0	
	4	Vin	7.48	
	5	Vout	3.23	
	6	Sense (NU)	0	
	7	Error (reset output)	3.20	
	8	Shutdown input	7.48	
U330 3V Regulator	1	Vin	7.48	
	2	Ground	GND	
	3	Control input	7.48	
	4	Bypass capacitor	1.26	
	5	Vout	3.00	
U401 Microprocessor	1	PD4_SCK serial clock input	0	
	2	PD5_SS	3.23	ASFIC chip select
	3	PD6_VLIN	3.23	EEPROM chip select
	4	PG7_R_W	3.21	
	5	PG6_AS	3.23	
	6	PG0_XA13	3.23	
	7	PB7_ADDR15	0.026	
	8	PB6_ADDR14	0.028	
	9	PB3_ADDR11	3.06	

Table 11-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	10	PB1_ADDR9	3.05	
	11	PB2_ADDR10	0.16	
	12	VDD	3.23	
	13	VSS	GND	
	14	PBO_ADDR8	3.05	
	15	PB5_ADDR13	0.13	
	16	PG1_XA14	0.20	
	17	PG4_XA17	3.17	
	18	PG5_XA18	0	
	19	PG3_XA16	3.21	
	20	PG2_XA15	0.30	
	21	PB4_ADDR12	0.22	
	22	PF7_ADDR7	3.03	
	23	PF6_ADDR6	3.08	
	24	PF5_ADDR5	3.06	
	25	PF4_ADDR4	0.16	
	26	PF3_ADDR3	0.26	
	27	PF2_ADDR2	3.06	
	28	PF1_ADDR1	3.06	
	29	PFO_ADDR0	3.05	
	30	PC0_DATA0	0.69	
	31	PC1_DATA1	0.96	
	32	PC2_DATA2	1.10	
	33	PC3_DATA3	0.81	
	34	PC4_DATA4	0.62	
	35	PC5_DATA5	0.68	
	36	PC6_DATA6	0.67	
	37	PC7_DATA7	0.73	
	38	PH7_CSPROG	3.05	
	39	VDDL	3.23	
	40	VSSL	GND	
	41	PH6_CSGP2	3.23	
	42	PH5_CSGP1	3.23	
	43	PH4_CSIO	0	
	44	PH3_PW4	3.21	On/off control output
	45	PH2_PW3	0	

Table 11-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	46	PH1_PW2	3.00	
	47	PH0_PW1	3.23	Synth chip select
	48	XIRQ	3.00	
	49	PI7	1.48	RX enable
	50	PI6	0.01	TX enable
	51	PI5	3.23	
	52	PI4	0	Green LED enable
	53	PI3	0	Red LED enable
	54	PI2	0	
	55	PI1	0	
	56	PI0	2.98	Lock detect from U201-4
	57	MODB_VSTBY	3.22	Boot mode enable
	58	MODA_LIR	3.12	
	59	AVDD	3.23	
	60	PE7_AN7	3.20	
	61	PE6_AN6	3.20	
	62	PE5_AN5	2.91	VOX threshold detect
	63	PE4_AN4	0.73	RSSI input
	64	PE3_AN3	0.14	
	65	PE2_AN2	1.62	
	66	PE1_AN1	0 - 3.3 V	Volume control wiper
	67	PE0_AN0	2.48	33% of battery voltage
	68	VRL	0	
	69	VRH	3.20	
	70	AVSS	GND	
	71	PJ0_CSGP3	3.23	Side PTT button
	72	PJ1_CSGP4	0	External MIC PTT
	73	PJ2	3.23	
	74	PJ3	3.23	
	75	PJ4	3.23	
	76	PJ5	0	
	77	PJ6	3.23	Bottom option button
	78	PJ7	3.23	Top option button
	79	PA0_IC3	0	
	80	PA1_IC2	1.57	
	81	PA2_IC1	3.00	

Table 11-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	82	PA3_IC4_OC5_OC1	3.00	
	83	PA4_OC4_OC1	0	Squelch detect input
	84	PA5_OC3_OC1	0	Channel activity input
	85	PA6_OC2_OC1	0	
	86	PA7_PA1_OC1	0	
	87	VSSR	GND	
	88	VDDR	3.23	
	89	ECLK (NU)	1.60	
	90	EXTAL	1.70	Clock from U451-28
	91	XTAL	1.40	Not used
	92	VDDSYN	0	
	93	XFC (NU)	0	
	94	RESET	3.20	From U320
	95	LVOUT	0	
	96	IRQ	3.20	
	97	PD0_RXD	3.23	
	98	PD1_TXD	1.9	
	99	PD2_MISO	0	
	100	PD3_MOSI	3.23	
U402 EEPROM	1	Chip select	3.23	From U401-3
	2	Serial data out	0	
	3	Write protect	3.23	
	4	Vss	GND	
	5	Serial data in	3.23	
	6	Serial clock	0	
	7	Hold	3.23	
	8	Vcc	3.23	
U404 Flash ROM	1	A11	3.06	
	2	A9	3.08	
	3	A8	3.05	
	4	A13	0.13	
	5	A14	0.31	
	6	NC	3.17	
	7	EN_WE	3.21	From U401-4
	8	Vcc	3.23	
	9	RESET	3.20	

Table 11-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U404 Flash ROM	10	A16	3.17	
	11	A15	0.30	
	12	A12	0.22	
	13	A7	3.03	
	14	A6	3.08	
	15	A5	3.06	
	16	A4	0	
	17	A3	0.24	
	18	A2	3.08	
	19	A1	3.05	
	20	A0	3.05	
	21	D0	0.69	
	22	D1	0.94	
	23	D2	1.08	
	24	GND	GND	
	25	D3	0.78	
	26	D4	0.59	
	27	D5	0.66	
	28	D6	0.67	
	29	D7	0.75	
	30	EN_CE	3.01	From U401-38
	31	A10	0.16	
	32	EN_OE	0	From U401-86
U451 ASFIC_CMP	1	VDD for analog circuits	3.00	
	2	DISC audio input	1.34	From U510
	3	Ground for analog circuits	GND	
	4	DACU output	0	
	5	DACR output	0	
	6	DACG output	2.38 (typ)	Power set (TX mode)
	7	VOX peak detector output	2.91	
	8	PLCAP for DC integrator	0.40	
	9	SQIN	0.01	
	10	Universal audio input/output	0	
	11	VDD for DACs	4.95	
	12	SQCAP	0	
	13	GCB2 general purpose output	0	Audio PA_EN (unsquelched)

Table 11-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U451 ASFIC_CMP	14	GCB1 general purpose output	0	
	15	GCB0 general purpose output	3.00	BW select (25 kHz mode)
	16	Squelch channel activity output	0	To U401-84
	17	Squelch detect digital output	0	To U401-83
	18	PL/low speed data I/O	1.50	
	19	High speed data I/O	3.00	
	20	Chip select	3.23	From U401-2
	21	Serial clock input	0	
	22	Serial data input	3.23	
	23	Ground for clock synthesizer	GND	
	24	Loop filter cap for clock syn	0.74	
	25	PLCAP2 for LS integrator	1.17	
	26	Not used	0	
	27	Vdd for clock synthesizer	3.00	
	28	Clock synthesizer output	1.70	
	29	1200 Hz ref for MDC decode	3.00	
	30	GNDDO	GND	
	31	Ground for digital circuits	GND	
	32	Vdd for analog switches	4.96	
	33	Vdd for digital circuits	3.00	
	34	16.8 MHz master clock input	1.54	
	35	GCB3 general purpose output	3.00	Internal MIC enable
	36	TX audio return from option	0	
	37	GCB4 general purpose output	0	
	38	GCB5 general purpose output	0	
	39	RX audio send to option	1.48	
	40	Modulation output	1.50	To U201-10
	41	RX audio out to power amp	1.51	
	42	Flat TX audio return from option	0.20	
	43	RX audio return to option	1.50	
	44	Flat TX audio send to option	1.50	
	45	Vdd for audio path I/O filters	3.00	
	46	Mic audio input	1.50	
	47	Ground for audio path I/O filters	GND	
	48	Ext mic audio input (not used)	0	

Table 11-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U480 Dual Opamp	1	Unit 1 output	2.48	
	2	Unit 1 (-) input	2.48	
	3	Unit 1 (+) input	2.46	
	4	Ground	GND	
	5	Unit 2 (+) input	0.28	
	6	Unit 2 (-) input	0.29	
	7	Unit 2 output	0	
	8	Vcc	4.96	
U490 Audio Power Amp	1	Enable/shutdown	0.12	(Unsquelched)
	2	Bias reference	3.26	(Unsquelched)
	3	(+) input	3.26	(Unsquelched)
	4	(-) input	3.27	(Unsquelched)
	5	(-) output	3.25	(Unsquelched)
	6	Vcc	7.48	(Unsquelched)
	7	Ground	GND	
	8	(+) output	3.29	(Unsquelched)
U510 Dual Opamp	1	Unit 1 output	1.75	
	2	Unit 1 (-) input	1.56	
	3	Unit 1 (+) input	1.55	
	4	Ground	GND	
	5	Unit 2 (+) input	1.55	
	6	Unit 2 (-) input	1.56	
	7	Unit 2 output	1.38	
	8	Vcc	4.96	

1. All voltages are measured with a high-impedance digital voltmeter and expressed in volts DC relative to ground (0V).
2. Voltages are measured with a DC input voltage of 7.50 + .02 volts DC applied to the battery connector (J301).
3. All voltages are measured in the squelched receive mode, unless otherwise indicated.
4. Voltages are identical for VHF and UHF models unless otherwise indicated.

Notes:

Chapter 12 UHF Schematic Diagrams, Overlays, and Parts Lists

12.1 Introduction

This section provides schematic diagrams, overlays, and parts lists for the radio circuit boards and interface connections.

12.1.1 Notes For All Schematics and Circuit Boards

* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

1. Unless otherwise stated, resistance values are in ohms (K = 1000), capacitance values are in picofarads (pF) or microfarads (µF), and inductance values are in nanohenries (nH) or microhenries (µH).
2. DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. If the board has been removed from the chassis, the transmitter module mounting screws may be used for ground connection. (*Note: The antenna nut bracket is not connected to ground.*) Operating mode dependent voltages are followed by (RX) for receive mode, (TX) for transmit mode, (UNSQ) for unsquelched mode, etc.
3. RF voltages on VHF models are measured with a Fluke model 85 RF probe. The indicated voltages expressed in mV (RF) are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 100 mV (-7 dBm) RF signal applied to the antenna jack J140.
4. RF voltages on UHF models are measured both with a high-impedance RF voltmeter having a bandwidth in excess of 500 MHz (levels are expressed in dBm) and with a Fluke model 85 RF probe [levels are expressed in mV (RF)]. These indicated voltages are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms, and are only approximate for UHF frequency measurements. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 100 mV (-7 dBm) RF signal applied to the antenna jack J140.
5. Audio voltages are measured with a high-impedance AC rms voltmeter. The indicated voltages are expressed in mV rms. Receive mode voltages are followed by (RX) and are measured with an on-channel signal with 1 kHz modulation at 60% deviation (3 kHz for 25 kHz channels, or 1.5 kHz for 12.5 kHz channels). Transmit mode voltages are followed by (TX) and are measured with a 1 kHz, 10 mV rms signal present at the external microphone input (accessory connector J471 pin 4 hot and pin 7 ground).
6. Reference Designators are assigned in the following manner:

Ref. No. Series	Circuit Block
1-99	RF Front End
100-149	Transmitter RF Stages
150-200	Transmitter Power Control
201-250	Frequency Synthesizer
251-300	VCO

Ref. No. Series	Circuit Block
301-400	DC Regulation
401-450	Microprocessor
451-550	Audio

7. Circuit Block Interconnection Legend:

Name	Description
USWB+	Unswitched Battery Voltage (always on)
5V	5 volts (regulated)
5R	5 volts in RX mode only
5T	5 volts in TX mode only
RESET	Low-line reset signal from U320 to uP
D3_3V	Digital 3.3 volts (regulated)
3V	Analog 3 volts (regulated)
TX_ENA	Transmit enable signal from uP to transmitter
PWR_SET	DC voltage from ASFIC to TX power control
DEMOD	RX audio from backend to ASFIC
BW_SEL	Backend filter BW select from ASFIC
RSSI	RX signal strength indication from IFIC to uP
IF_IN/OUT	44.85 MHz from 1st mixer to high IF filter
RF_IN/OUT	RX signal from antenna switch to front end
MOD OUT/IN	TX modulation from ASFIC to synthesizer
16_8_MHZ	Ref osc signal from synthesizer to ASFIC
SYNTH_CS	Synthesizer chip select from uP
SPI_CLK	Serial clock from uP
SPI_DATA_OUT	Serial data from uP
LOCK	Lock detect indication from synth to uP
PRESC	VCO freq feedback from VCOBIC to synth
V_STEER	Steering line voltage from synth to VCO's
V_SF	Super-filtered 4.5 volts from synth to VCOBIC
VCO_MOD	TX modulation from ASFIC to synthesizer
TRB	TX/RX control from synth to VCOBIC
RX_INJ	Buffered RX VCO output to RX 1st mixer
TX_INJ	TX VCO output to transmitter input

12.1.2 Six Layer Circuit Board

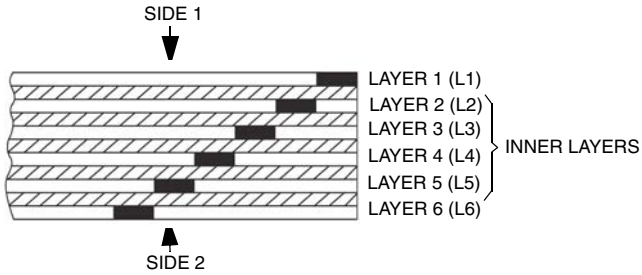

Figure 12-1. Six-Layer Circuit Board: Copper Steps in Layer Sequence

12.2 Speaker and Microphone Schematic

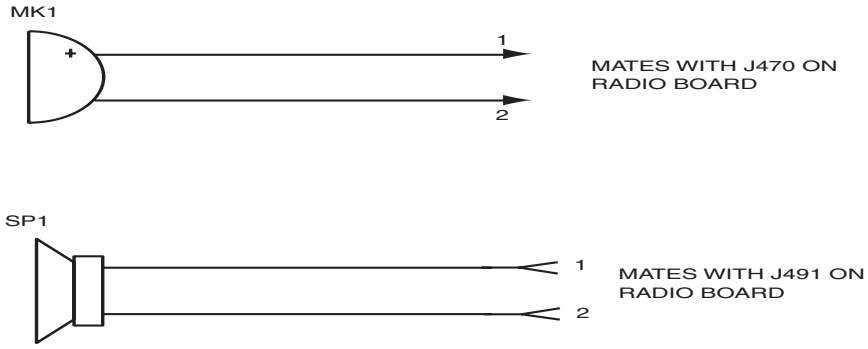

Figure 12-2. Speaker and Microphone Schematic

12.2.1 Speaker and Microphone Parts List

Reference Designator	Motorola Part No.	Description
MK1	5080258E16	Microphone, electret
SP1	5005679X04	Speaker assembly with connector

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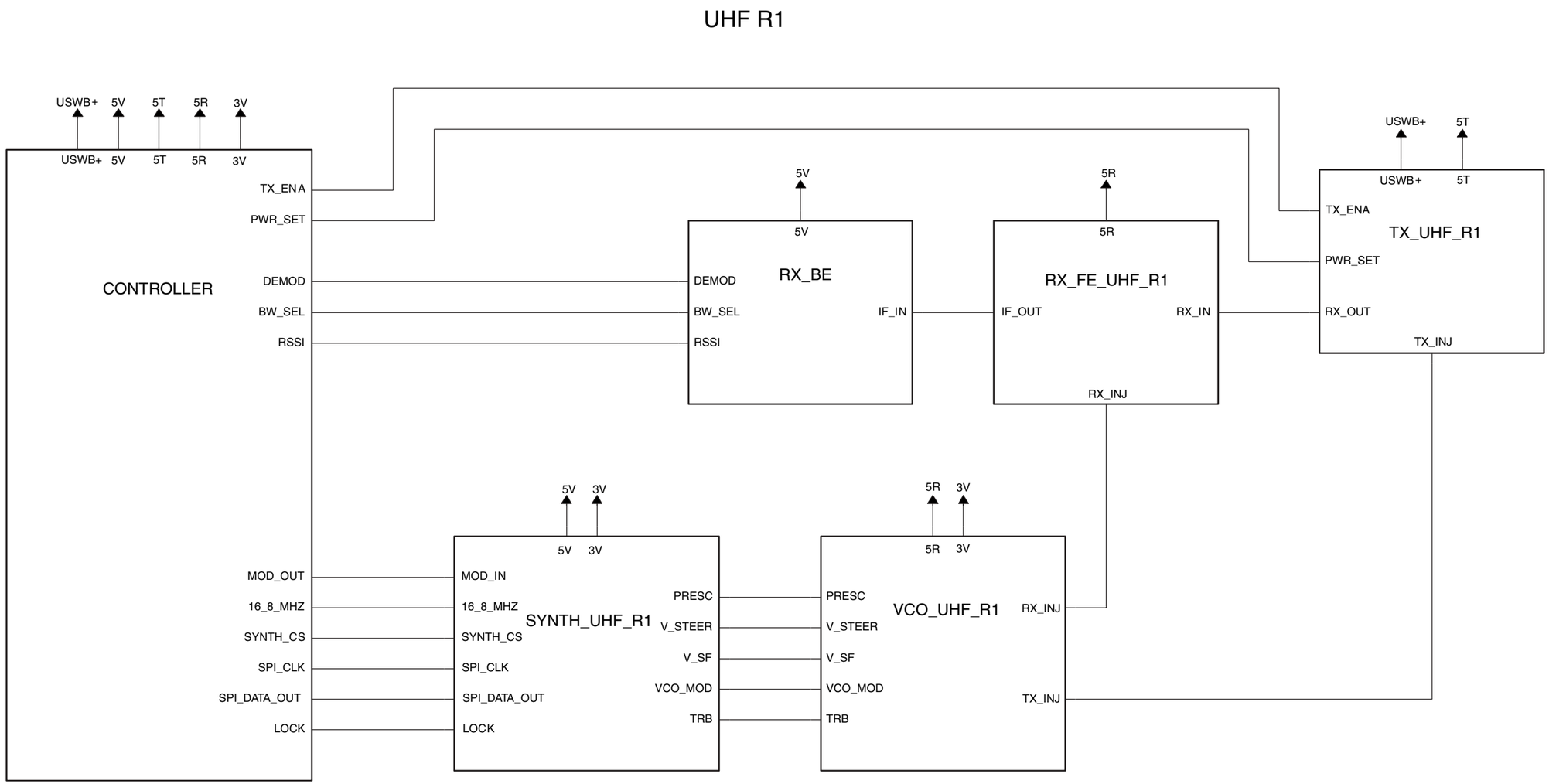


Figure 12-3. UHF (403-440 MHz) Radio Circuit Block Diagram (8486635Z03-O)

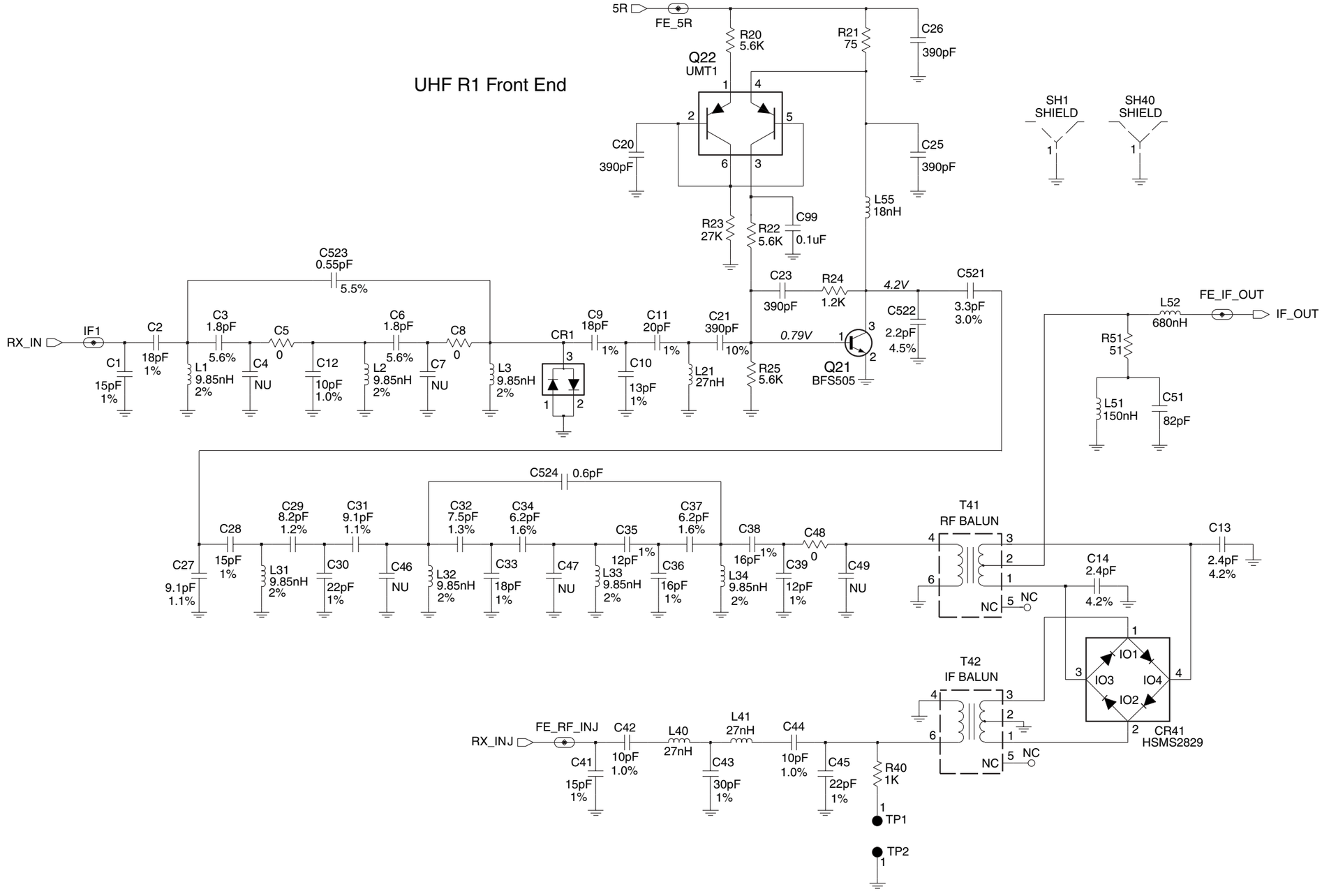


Figure 12-4. UHF (403-440 MHz) Receiver Front End Schematic Diagram (8486635Z03-O)

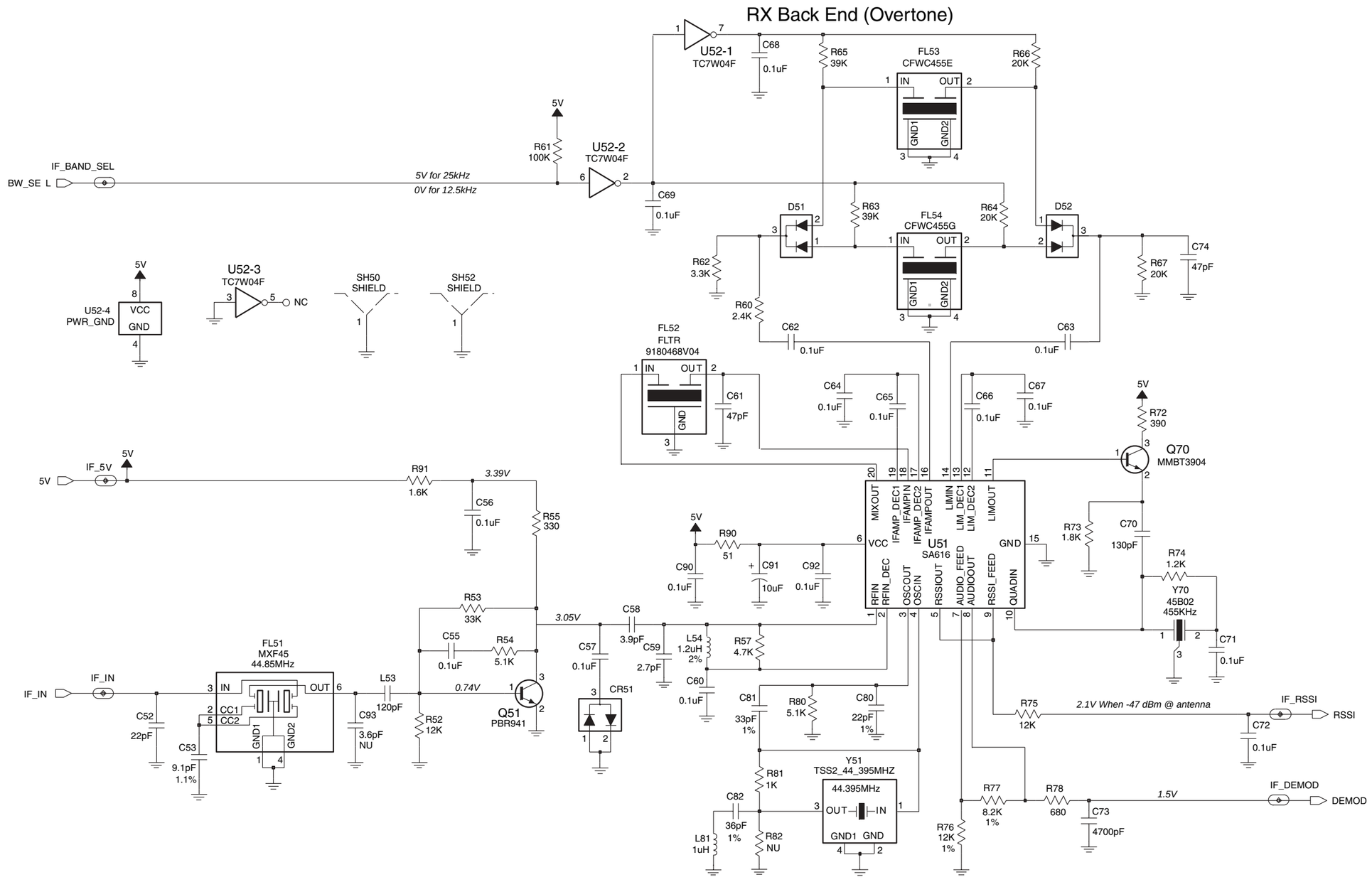
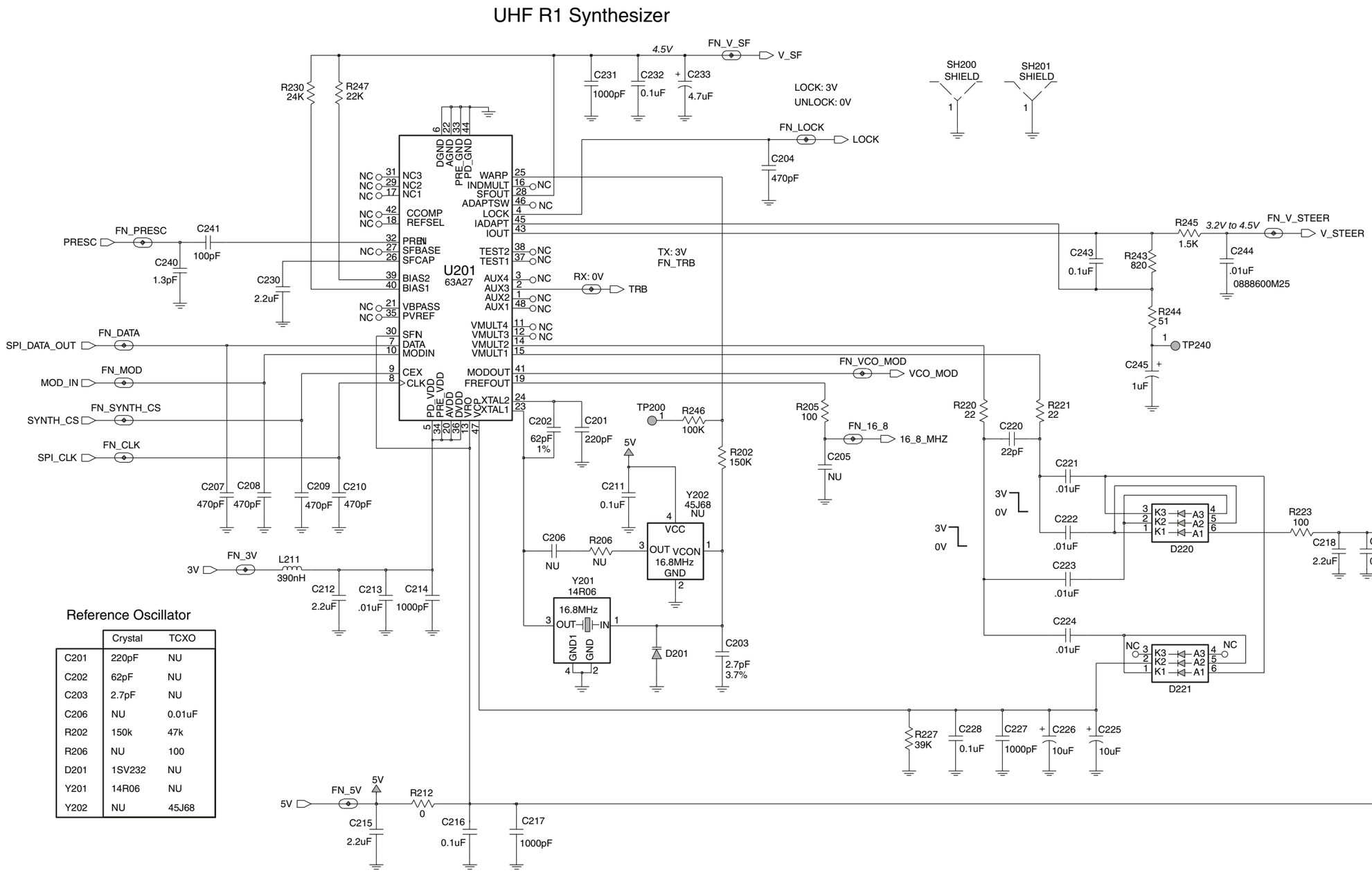


Figure 12-5. UHF (403-440 MHz) Receiver Back End Schematic Diagram (8486635Z03-O)



	Crystal	TCXO
C201	220pF	NU
C202	62pF	NU
C203	2.7pF	NU
C206	NU	0.01uF
R202	150k	47k
R206	NU	100
D201	1SV232	NU
Y201	14R06	NU
Y202	NU	45J68

Figure 12-6. UHF (403-440 MHz) Synthesizer Schematic Diagram (8486635Z03-O)

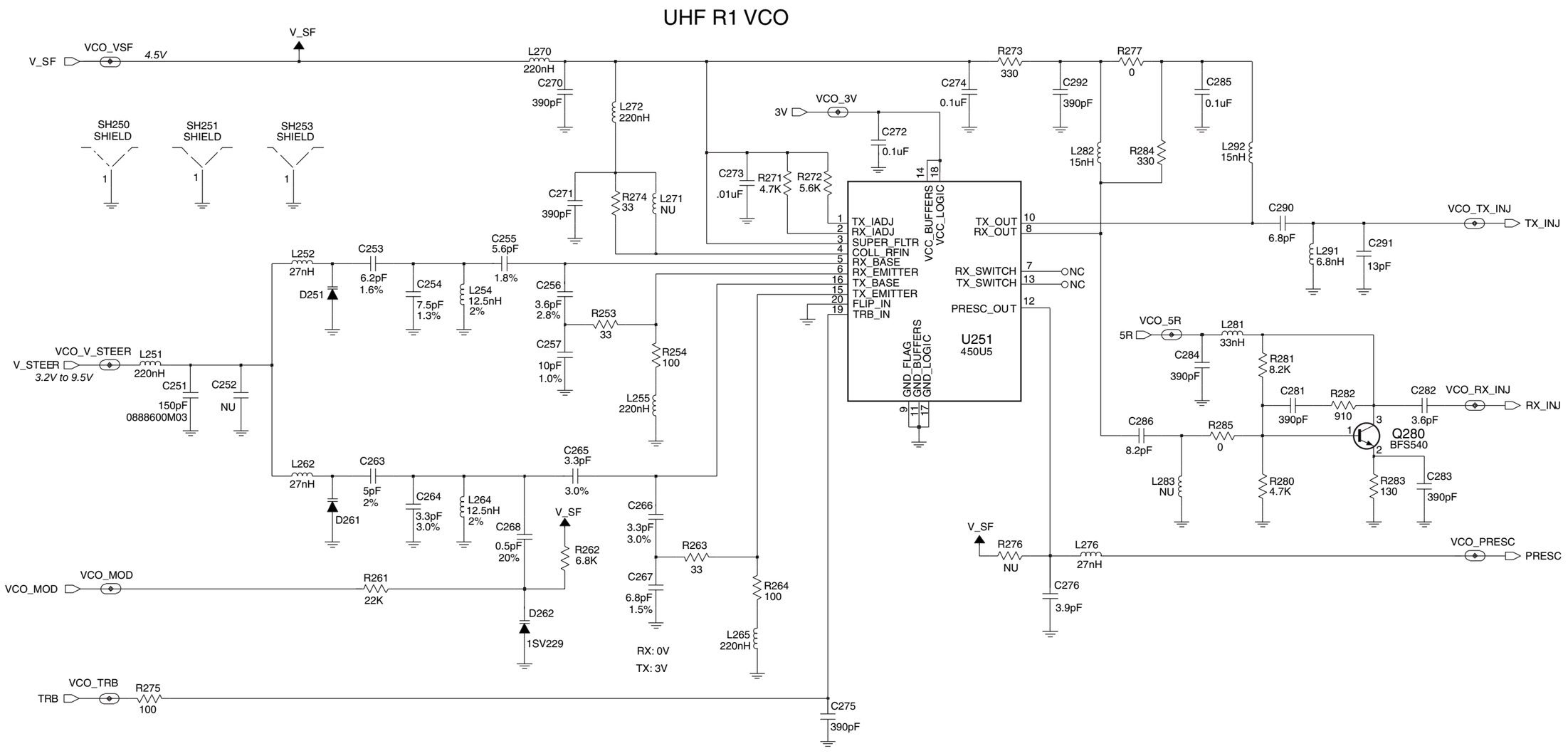


Figure 12-7. UHF (403-440 MHz) Voltage Controlled Oscillator Schematic Diagram (8486635Z03-O)

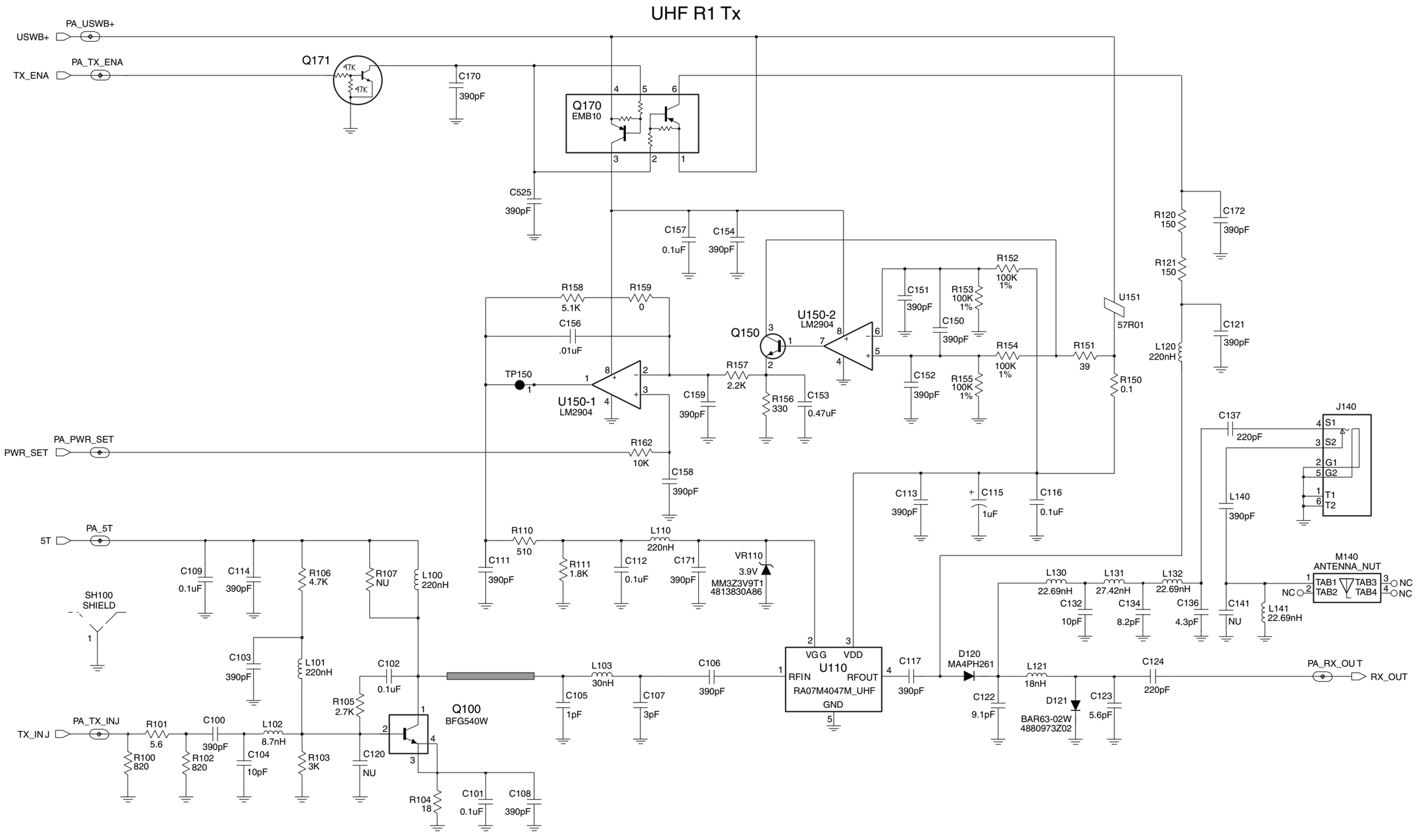


Figure 12-8. UHF (403-440 MHz) Transmitter and Power Control Schematic Diagram (8486635Z03-O)

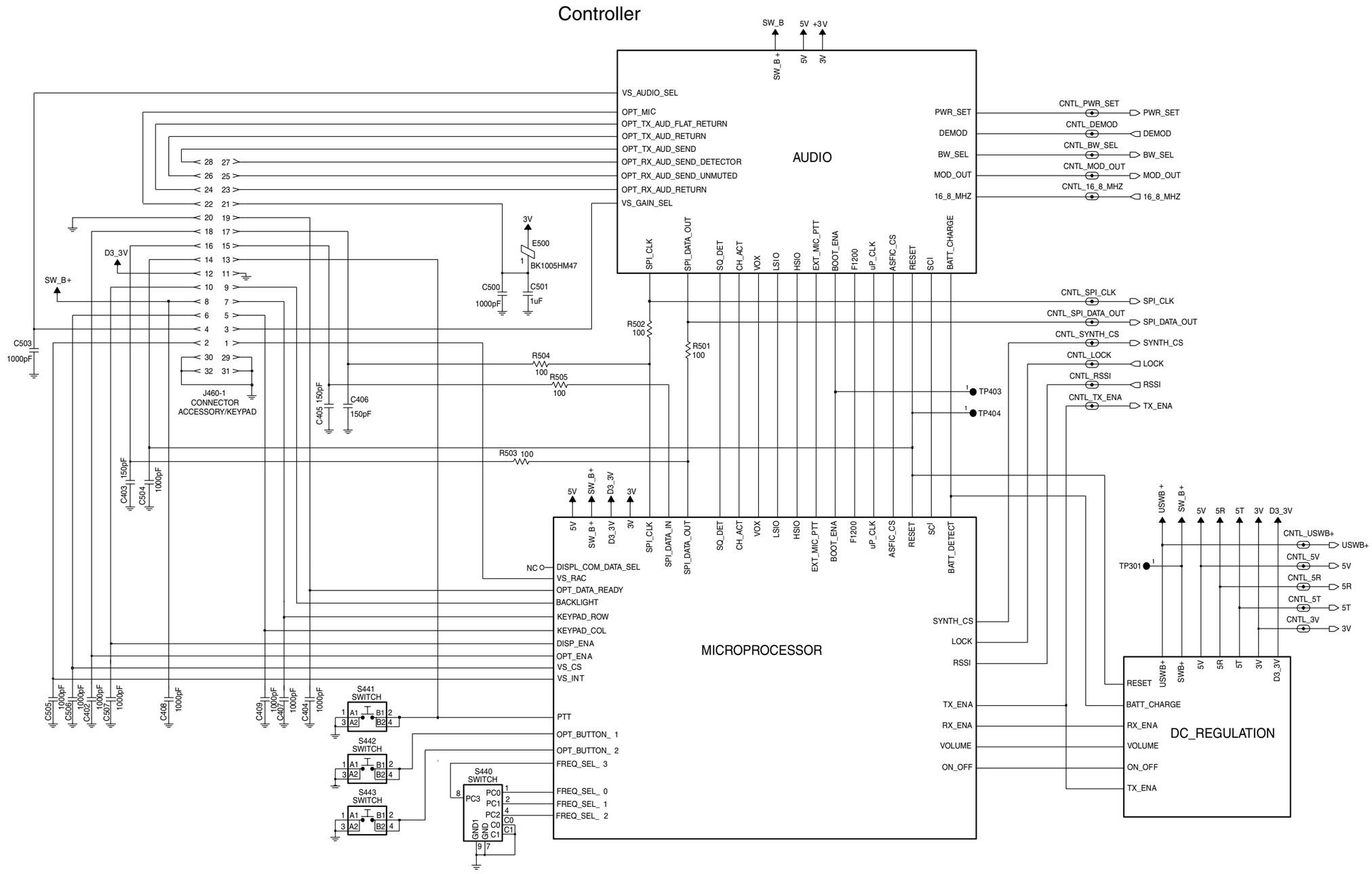


Figure 12-9. UHF (403-440 MHz) Controller Interconnect Schematic Diagram (8486635Z03-O)

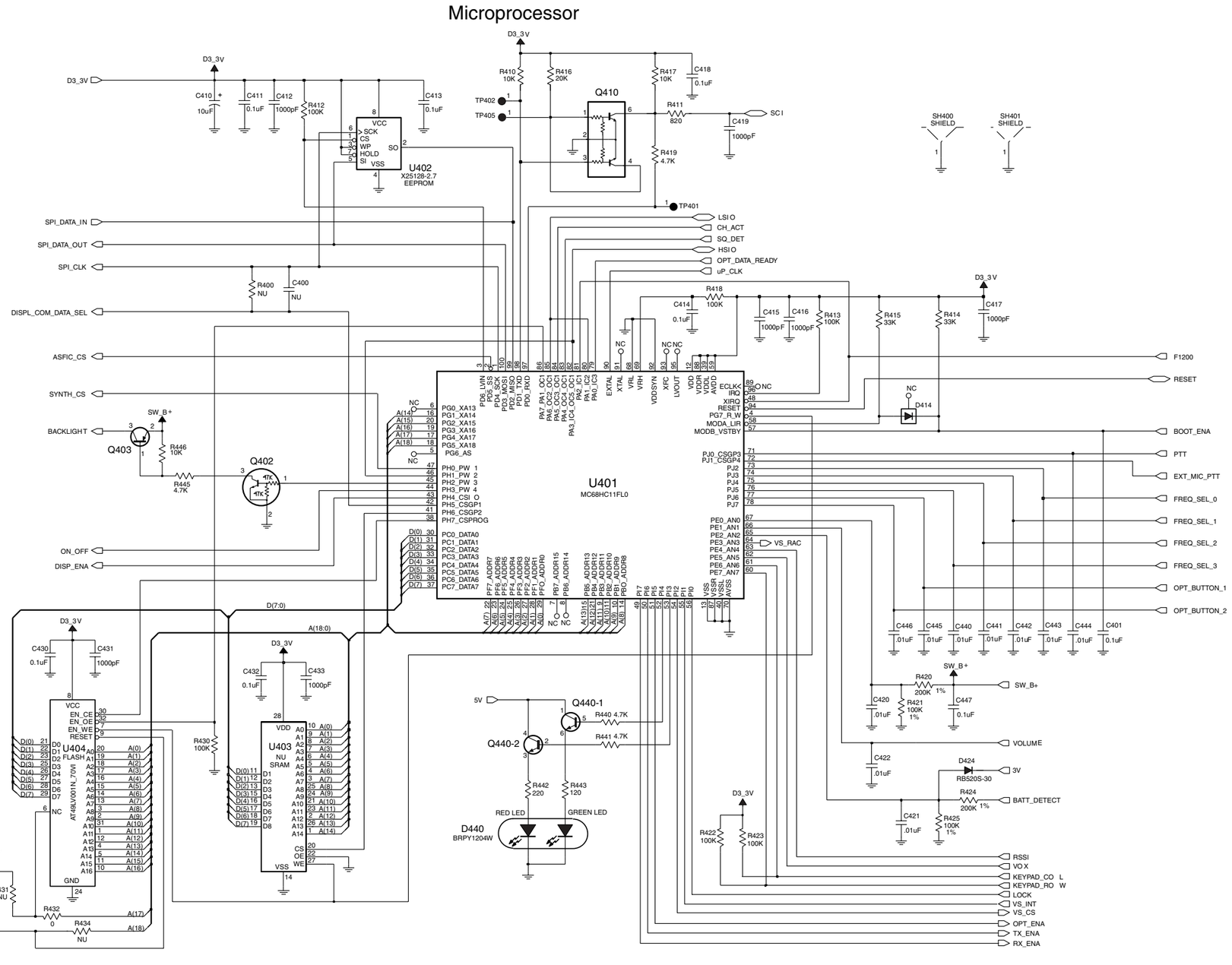
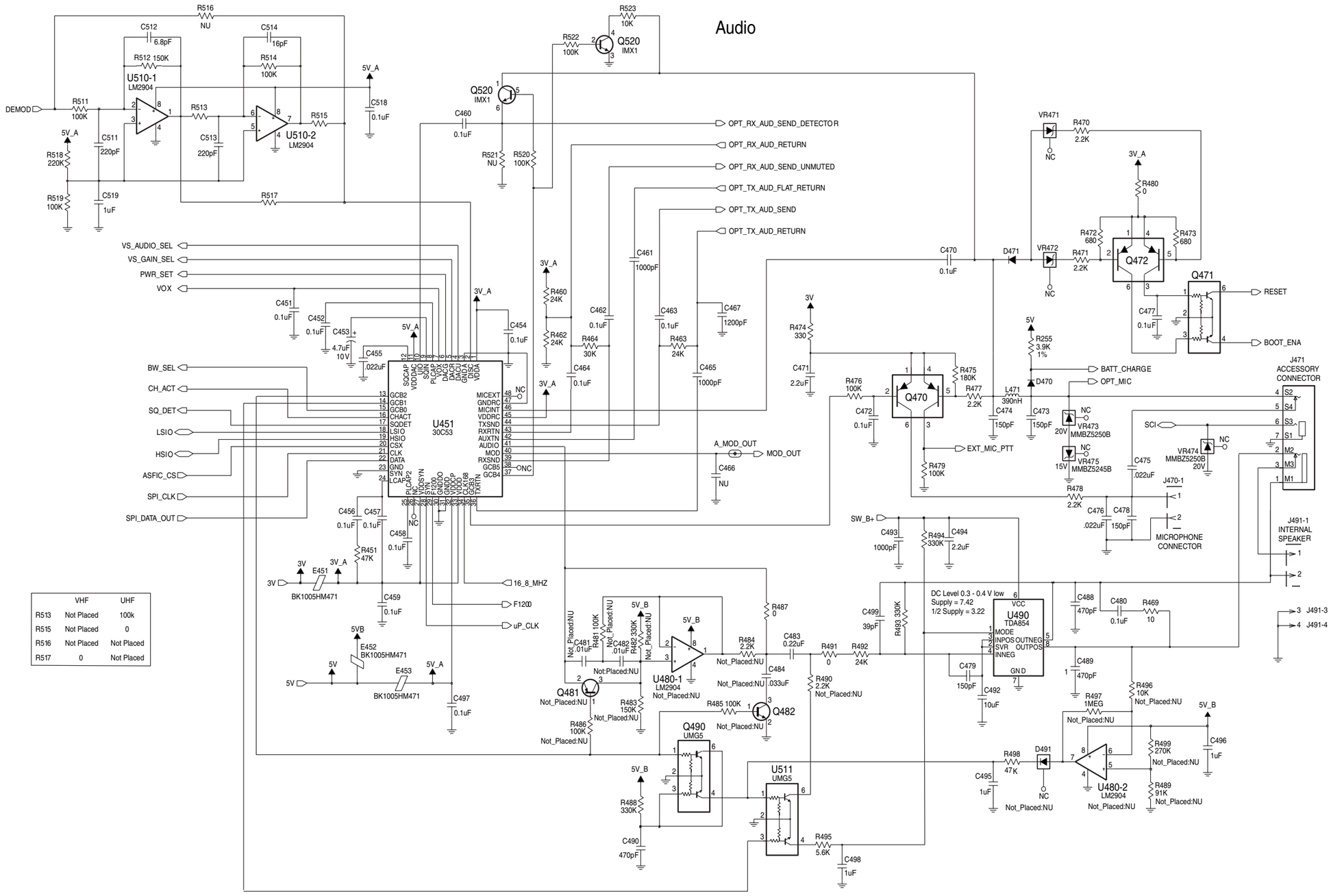


Figure 12-10. UHF (403-440 MHz) Microprocessor Circuitry Schematic Diagram (8486635Z03-O)



	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

Figure 12-11. UHF (403-440MHz) Audio Circuitry Schematic Diagram (8486635Z03-O)

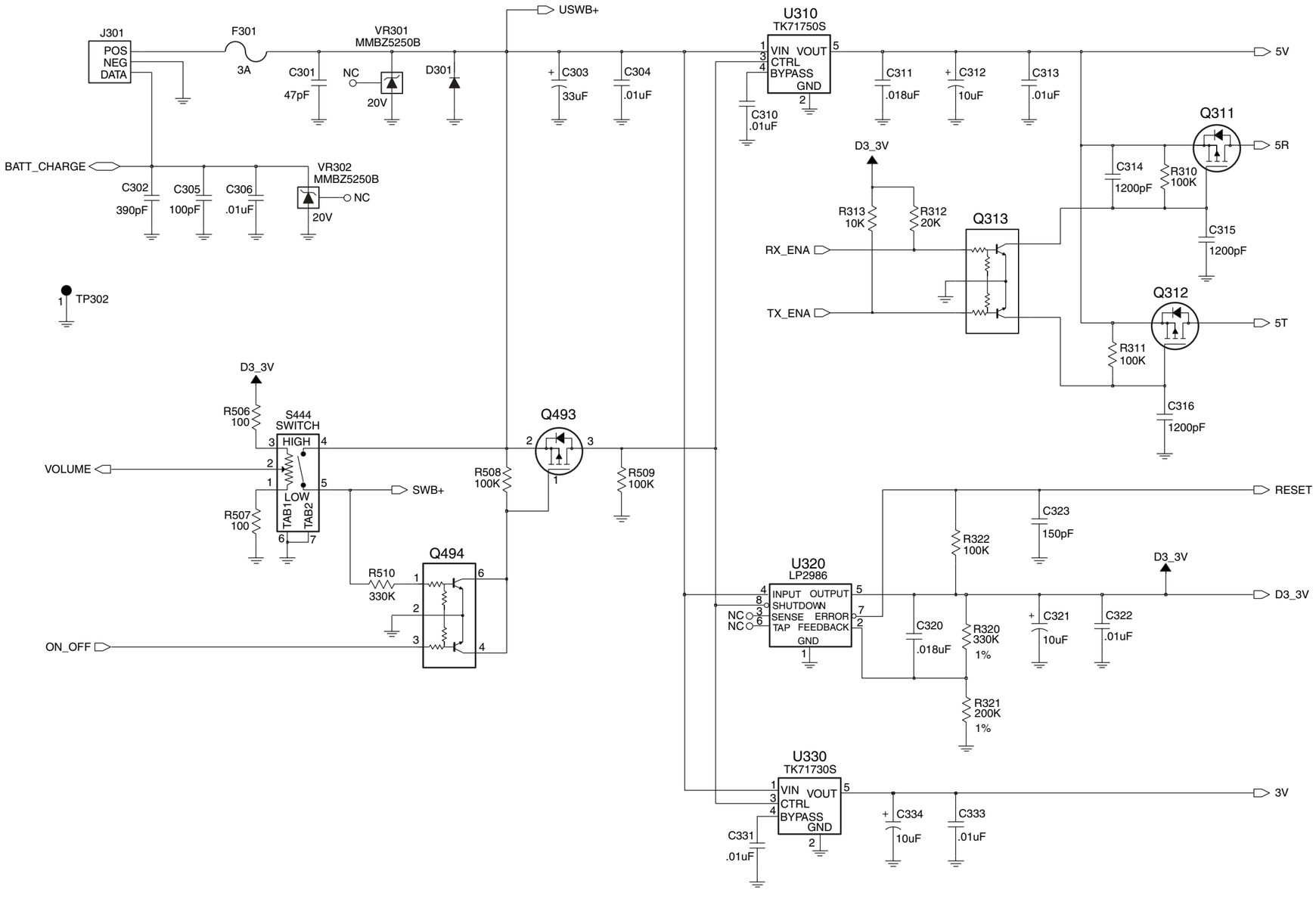
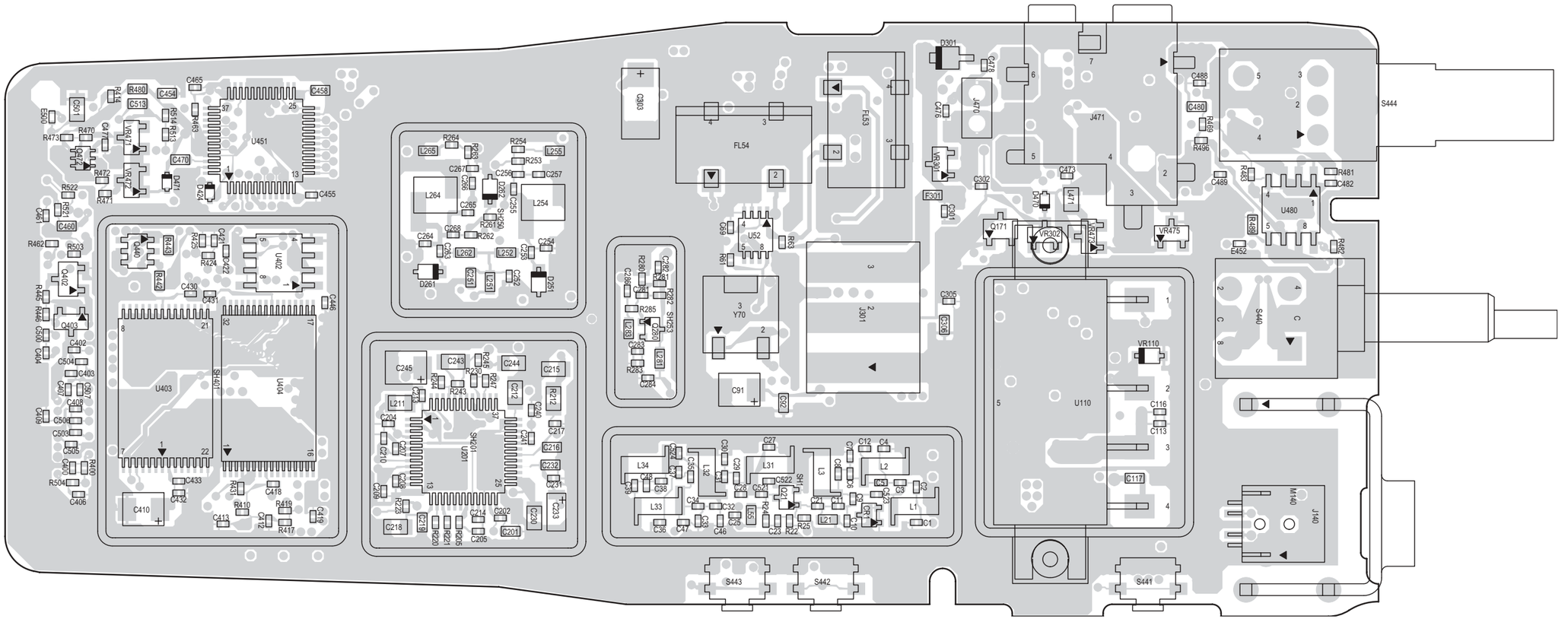


Figure 12-12. UHF (403-440 MHz) DC Regulation Schematic Diagram (8486635Z03-O)


U451
U403
U404
U402
U440
U52
U480
U110
U201
Y70
FL54
FL53
J470
J471
J301
S444
S440
S443
S442
S441
VR110
VR302
VR475
Q171
M140
J140
E452
C91
C410
C432
C433
C430
C431
C446
C455
C458
C465
C454
C480
C488
C489
C302
C305
C306
C301
C473
C476
C478
D301
F301
D470
D471
D424
D261
D262
D285
L264
L265
L254
L255
L262
L252
L251
L211
L201
L202
L203
L204
L205
L206
L207
L208
L209
L210
L211
L212
L213
L214
L215
L216
L217
L218
L219
L220
L221
L222
L223
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L227
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L230
L231
L232
L233
L234
L235
L236
L237
L238
L239
L240

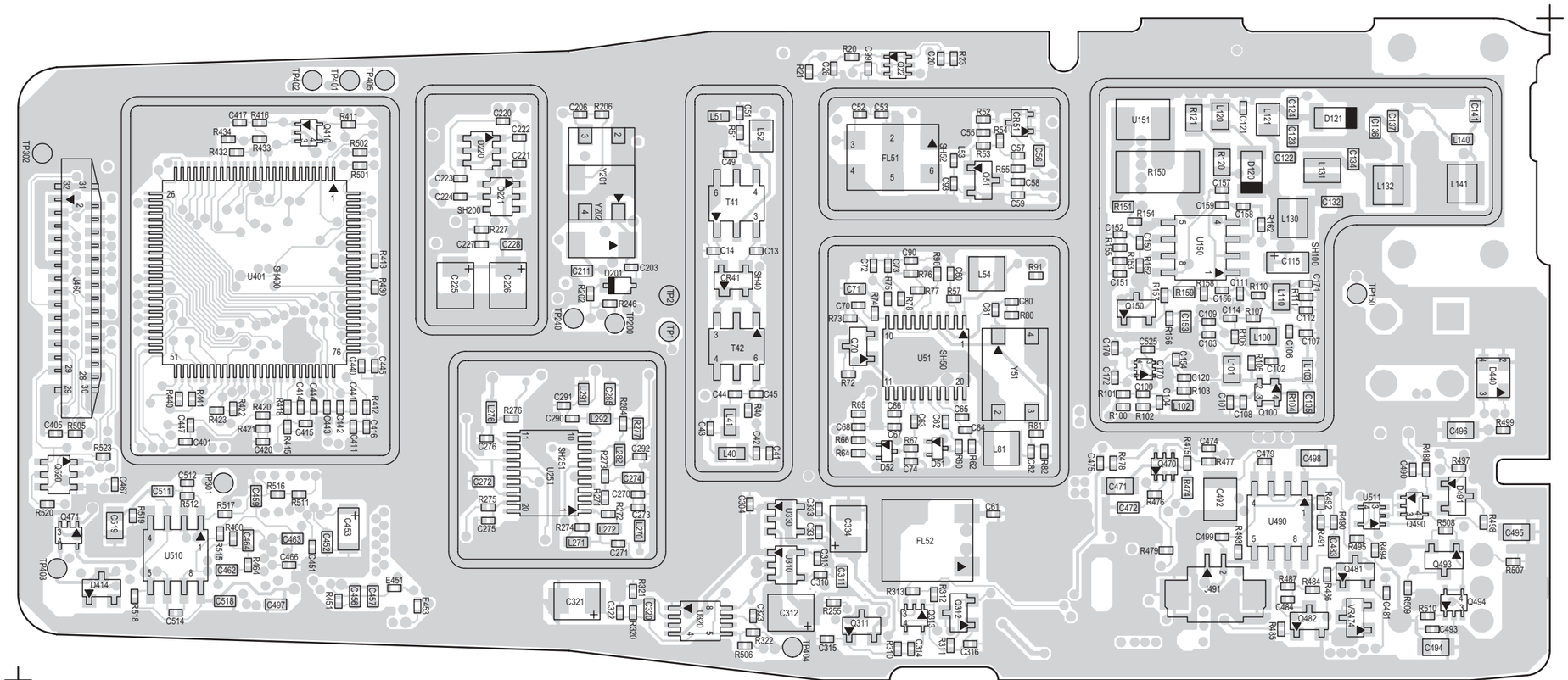


Figure 12-14. UHF (403-440 MHz) Board Solder Side View (8486635Z03-O)

UHF (403-440 MHz) Radio Parts List (8486635Z03-O)

Circuit Ref	Motorola Part No.	Description
C1	2109445U37	CAP, 15pF
C2	2109445U39	CAP, 18pF
C3	2109445U09	CAP, 1.8pF
C4	Not_Placed	CAP, 20pF
C5	0662057M01	RES, 0
C6	2109445U09	CAP, 1.8pF
C7	Not_Placed	CAP, 22pF
C8	0662057M01	RES, 0
C9	2109445U39	CAP, 18pF
C10	2109445U36	CAP, 13pF
C11	2109445U40	CAP, 20pF
C12	2109445U27	CAP, 10pF
C13	2109445U12	CAP, 2.4pF
C14	2109445U12	CAP, 2.4pF
C20	2113743L07	CAP, 390pF
C21	2113743L07	CAP, 390pF
C23	2113743L07	CAP, 390pF
C25	2113743L07	CAP, 390pF
C26	2113743L07	CAP, 390pF
C27	2109445U26	CAP, 9.1pF
C28	2109445U37	CAP, 15pF
C29	2109445U25	CAP, 8.2pF
C30	2109445U41	CAP, 22pF
C31	2109445U26	CAP, 9.1pF
C32	2109445U24	CAP, 7.5pF
C33	2109445U39	CAP, 18pF
C34	2109445U22	CAP, 6.2pF
C35	2109445U35	CAP, 12pF
C36	2109445U38	CAP, 16pF
C37	2109445U22	CAP, 6.2pF
C38	2109445U38	CAP, 16pF
C39	2109445U35	CAP, 12pF
C41	2109445U37	CAP, 15pF
C42	2109445U27	CAP, 10pF
C43	2109445U44	CAP, 30pF
C44	2109445U27	CAP, 10pF
C45	2109445U41	CAP, 22pF
C46	Not_Placed	CAP, 10pF
C47	Not_Placed	CAP, 10pF
C48	0662057M01	RES, 0
C49	Not_Placed	CAP, 3.9pF
C51	2113743N48	CAP, 82pF
C52	2109445U39	CAP, 18pF
C53	2109445U26	CAP, 9.1pF
C55	2113743M24	CAP, 0.1uF
C56	2113743E20	CAP, 0.1uF
C57	2113743M24	CAP, 0.1uF
C58	2113743N16	CAP, 3.9pF
C59	2113743N12	CAP, 2.7pF
C60	2113743M24	CAP, 0.1uF
C61	2113743N46	CAP, 68pF
C62	2113743M24	CAP, 0.1uF
C63	2113743M24	CAP, 0.1uF
C64	2113743M24	CAP, 0.1uF
C65	2113743M24	CAP, 0.1uF
C66	2113743M24	CAP, 0.1uF
C67	2113743M24	CAP, 0.1uF
C68	2113743M24	CAP, 0.1uF
C69	2113743M24	CAP, 0.1uF
C70	2113743N53	CAP, 130pF
C71	2113743E20	CAP, 0.1uF
C72	2113743M24	CAP, 0.1uF
C73	2113743L33	CAP, 4700pF
C74	2113743N42	CAP, 47pF
C80	2109445U41	CAP, 22pF
C81	2109445U45	CAP, 33pF
C82	2109445U45	CAP, 33pF
C90	2113743M24	CAP, 0.1uF
C91	2311049A57	CAPP, 10uF
C92	2113743E20	CAP, 0.1uF
C93	Not_Placed	CAP, 3.6pF
C99	2113743M24	CAP, 0.1uF
C100	2113743L07	CAP, 390pF
C101	2113743M24	CAP, 0.1uF
C102	2113743M24	CAP, 0.1uF
C103	2113743L07	CAP, 390pF
C104	2113743N26	CAP, 10pF
C105	2113740F03	CAP, 1pF
C106	2113743L07	CAP, 390pF
C107	2113743N13	CAP, 3pF
C108	2113743L07	CAP, 390pF
C109	2113743M24	CAP, 0.1uF
C111	2113743L07	CAP, 390pF
C112	2113743M24	CAP, 0.1uF
C113	2113743L07	CAP, 390pF
C114	2113743L07	CAP, 390pF
C115	2311049A07	CAPP, 1uF
C116	2113743M24	CAP, 0.1uF
C117	2113740F65	CAP, 390pF
C120	Not_Placed	CAP, 8.2pF
C121	2113743L07	CAP, 390pF
C122	2113740F26	CAP, 9.1pF
C123	2113740F21	CAP, 5.6pF
C124	2113740F59	CAP, 220pF
C132	2113740F27	CAP, 10pF
C134	2113740F25	CAP, 8.2pF
C136	2113740F18	CAP, 4.3pF
C137	2113740F59	CAP, 220pF
C141	Not_Placed	CAP, 8.2pF
C150	2113743L07	CAP, 390pF
C151	2113743L07	CAP, 390pF
C152	2113743L07	CAP, 390pF
C153	2113743K18	CAP, 0.47uF
C154	2113743L07	CAP, 390pF
C156	2113743L41	CAP, .01uF
C157	2113743M24	CAP, 0.1uF
C158	2113743L07	CAP, 390pF
C159	2113743L07	CAP, 390pF
C170	2113743L07	CAP, 390pF
C171	2113743L07	CAP, 390pF
C172	2113743L07	CAP, 390pF
C201	2113740F59	CAP, 220pF
C202	2109445U52	CAP, 62pF
C203	2109445U13	CAP, 2.7pF
C204	2113743L09	CAP, 470pF
C205	Not_Placed	CAP, 2.7pF
C206	Not_Placed	CAP, 1000pF
C207	2113743L09	CAP, 470pF
C208	2113743L09	CAP, 470pF
C209	2113743L09	CAP, 470pF
C210	2113743L09	CAP, 470pF
C211	2113743E20	CAP, 0.1uF
C212	2113743F18	CAP, 2.2uF
C213	2113743L41	CAP, .01uF
C214	2113743L17	CAP, 1000pF
C215	2113743F18	CAP, 2.2uF
C216	2113743E20	CAP, 0.1uF
C217	2113743L17	CAP, 1000pF
C218	2113743F18	CAP, 2.2uF
C219	2113743E20	CAP, 0.1uF
C220	2113743N34	CAP, 22pF
C221	2113743L41	CAP, .01uF
C222	2113743L41	CAP, .01uF
C223	2113743L41	CAP, .01uF
C224	2113743L41	CAP, .01uF
C225	2311049A57	CAPP, 10uF
C226	2311049A57	CAPP, 10uF
C227	2113743L17	CAP, 1000pF
C228	2113743E20	CAP, 0.1uF
C230	2113743F18	CAP, 2.2uF
C231	2113743L17	CAP, 1000pF
C232	2113743E20	CAP, 0.1uF
C233	2311049A56	CAPP, 4.7uF
C240	2113743N06	CAP, 1.3pF
C241	2113743N50	CAP, 100pF
C243	0886641Z01	CAP, 0.1uF
C244	0888600M25	CAP, .01uF
C245	2311049A08	CAPP, 1uF
C251	0888600M03	CAP, 150pF
C252	Not_Placed	CAP, 390pF
C253	2109445U22	CAP, 6.2pF
C254	2109445U24	CAP, 7.5pF
C255	2109445U21	CAP, 5.6pF
C256	2109445U16	CAP, 3.6pF
C257	2109445U27	CAP, 10pF
C263	2109445U29	CAP, 5pF
C264	2109445U15	CAP, 3.3pF
C265	2109445U15	CAP, 3.3pF
C266	2109445U15	CAP, 3.3pF
C267	2109445U23	CAP, 6.8pF
C268	2109445U01	CAP, 0.5pF
C270	2113743L07	CAP, 390pF
C271	2113743L07	CAP, 390pF
C272	2113743E20	CAP, 0.1uF
C273	2113743L41	CAP, .01uF
C274	2113743E20	CAP, 0.1uF
C275	2113743L07	CAP, 390pF
C276	2113743N16	CAP, 3.9pF
C281	2113743L07	CAP, 390pF
C282	2109445U16	CAP, 3.6pF
C283	2113743L07	CAP, 390pF
C284	2113743L07	CAP, 390pF
C285	2113743E20	CAP, 0.1uF
C286	2113743N24	CAP, 8.2pF
C290	2113743N22	CAP, 6.8pF
C291	2113743N29	CAP, 13pF
C292	2113743L07	CAP, 390pF
C301	2113743L07	CAP, 390pF
C302	2113743L07	CAP, 390pF
C303	2311049A97	CAPP, 33uF
C304	2113743L41	CAP, .01uF
C305	2113743N50	CAP, 100pF
C306	2113741F49	CAP, .01uF
C310	2113743L41	CAP, .01uF
C311	2113743E05	CAP, .018uF
C312	2311049A57	CAPP, 10uF
C313	2113743L41	CAP, .01uF
C314	2113743L19	CAP, 1200pF
C315	2113743L19	CAP, 1200pF
C316	2113743L19	CAP, 1200pF
C320	2113743E05	CAP, .018uF
C321	2311049A57	CAPP, 10uF
C322	2113743L41	CAP, .01uF
C323	2113743N54	CAP, 150pF
C331	2113743L41	CAP, .01uF
C333	2113743L41	CAP, .01uF
C334	2311049A57	CAPP, 10uF
C400	Not_Placed	CAP, .022uF
C401	2113743M24	CAP, 0.1uF
C402	2113743L17	CAP, 1000pF
C403	2113743N50	CAP, 150pF
C404	2113743L17	CAP, 1000pF
C405	2113743N50	CAP, 150pF

Circuit Ref	Motorola Part No.	Description
C406	2113743N50	CAP, 150pF
C407	2113743L17	CAP, 1000pF
C408	2113743L17	CAP, 1000pF
C409	2113743L17	CAP, 1000pF
C410	2311049A57	CAPP, 10uF
C411	2113743M24	CAP, 0.1uF
C412	2113743L17	CAP, 1000pF
C413	2113743M24	CAP, 0.1uF
C414	2113743M24	CAP, 0.1uF
C415	2113743L17	CAP, 1000pF
C416	2113743L17	CAP, 1000pF
C417	2113743L17	CAP, 1000pF
C418	2113743M24	CAP, 0.1uF
C419	2113743L17	CAP, 1000pF
C420	2113743L41	CAP, .01uF
C421	2113743L41	CAP, .01uF
C422	2113743L41	CAP, .01uF
C430	2113743M24	CAP, 0.1uF
C431	2113743L17	CAP, 1000pF
C432	2113743M24	CAP, 0.1uF
C433	2113743L17	CAP, 1000pF
C440	2113743L41	CAP, .01uF
C441	2113743L41	CAP, .01uF
C442	2113743L41	CAP, .01uF
C443	2113743L41	CAP, .01uF
C444	2113743L41	CAP, .01uF
C445	2113743L41	CAP, .01uF
C446	2113743L41	CAP, .01uF
C447	2113743M24	CAP, 0.1uF
C451	2113743M24	CAP, 0.1uF
C452	2113743E20	CAP, 0.1uF
C453	2311049A56	CAPP, 4.7uF
C454	2113743E20	CAP, 0.1uF
C455	2113743L48	CAP, .022uF
C456	2113743E20	CAP, 0.1uF
C457	2113743E20	CAP, 0.1uF
C458	2113743E20	CAP, 0.1uF
C459	2113743E20	CAP, 0.1uF
C460	2113743E20	CAP, 0.1uF
C461	2113743L17	CAP, 1000pF
C462	2113743E20	CAP, 0.1uF
C463	2113743E20	CAP, 0.1uF
C464	2113743E20	CAP, 0.1uF
C465	2113743L17	CAP, 1000pF
C466	Not_Placed	CAP, 470pF
C467	2113743L19	CAP, 1200pF
C470	2113743E20	CAP, 0.1uF
C471	2113743F18	CAP, 2.2uF
C472	2113743E20	CAP, 0.1uF
C473	2113743N54	CAP, 150pF
C474	2113743N54	CAP, 150pF
C475	2113743L48	CAP, .022uF
C476	2113743L48	CAP, .022uF
C477	2113743M24	CAP, 0.1uF
C478	2113743N54	CAP, 150pF
C479	2113743N54	CAP, 150pF
C480	2113743E20	CAP, 0.1uF
C481	Not_Placed	CAP, .01uF
C482	Not_Placed	CAP, .01uF
C483	2113928H02	CAP, 0.22uF
C484	Not_Placed	CAP, .033uF
C488	2113743L09	CAP, 470pF
C489	2113743L09	CAP, 470pF
C490	2113743L09	CAP, 470pF
C492	2113928J08	CAP, 10uF
C493	2113743L17	CAP, 1000pF
C494	2113743F18	CAP, 2.2uF
C495	2113743F16	CAP, 1uF
C496	2113743F16	CAP, 1uF
C497	2113743E20	CAP, 0.1uF
C498	2113743F16	CAP, 1uF
C499	2113743N40	CAP, 39pF
C500	2113743L17	CAP, 1000pF
C501	2113743F16	CAP, 1uF
C503	2113743L17	CAP, 1000pF
C504	2113743L17	CAP, 1000pF
C505	2113743L17	CAP, 1000pF
C506	2113743L17	CAP, 1000pF
C507	2113743L17	CAP, 1000pF
C511	2113740F59	CAP, 220pF
C512	2113743N22	CAP, 6.8pF
C513	2113740F59	CAP, 220pF
C514	2113743N31	CAP, 16pF
C518	2113743E20	CAP, 0.1uF
C519	2113743F16	CAP, 1uF
C521	2109445U15	CAP, 3.3pF
C522	2109445U11	CAP, 2.2pF
C523	2186463Z04	CAP, 0.55pF
C524	2186463Z05	CAP, 0.6pF
C525	2113743L07	CAP, 390pF
CR1	4813825A19	MMBD352
CR41	4802246J04	HSMS2829
CR51	4813825A19	MMBD352
D51	4802245J97	DAN235ETL
D52	4802245J97	DAN235ETL
D120	4880973Z02	MA4PH261
D121	4880973Z02	MA4PH261
D201	4862824C03	1SV232
D220	4802233J09	IMN10
D221	4802233J09	IMN10
D251	4862824C01	1SV229
D261	4862824C01	1SV229
D262	4862824C01	1SV229
D301	4813833A19	MBRM120ET3
D414	4805129M41	MMBD501
D424	4809924D18	RB520S-30
D440	4805729G49	BRPY1204W
D470	4809924D18	RB520S-30
D471	4809924D18	RB520S-30
D491	Not_Placed	MMBD501
E451	2480640Z01	BK1005HM471
E452	2480640Z01	BK1005HM471
E453	2480640Z01	BK1005HM471
E500	2480640Z01	BK1005HM471
F301	6580542Z01	FUSE
FL51	9180022M11	MXF45
FL52	9180468V04	FLTR
FL53	9180469V05	CFWC455E
FL54	9180469V03	CFWC455G
J140	0986428Z01	CONN_J
J301	0986565Z01	CONN_J
J460	Not_Placed	CONN_J
J470	0985818A01	CONN_J
J471	0980683Z03	CONN_J
J491	2809926G01	CONN_P
L1	2409348J15	IDCTR, 9.85nH
L2	2409348J15	IDCTR, 9.85nH
L3	2409348J15	IDCTR, 9.85nH
L21	2413926N17	IDCTR, 27nH
L31	2409348J15	IDCTR, 9.85nH
L32	2409348J15	IDCTR, 9.85nH
L33	2409348J15	IDCTR, 9.85nH
L34	2409348J15	IDCTR, 9.85nH
L40	2413926K16	IDCTR, 27nH
L41	2413926K16	IDCTR, 27nH
L51	2413926N26	IDCTR, 150nH
L52	2462587V44	IDCTR, 680nH
L53	2113743N52	CAP, 120pF
L54	2413923A25	IDCTR, 1.2uH
L55	2413926N15	IDCTR, 18nH
L81	2413923A19	IDCTR, 1uH
L100	2413926K27	IDCTR, 220nH
L101	2413926K27	IDCTR, 220nH
L102	2409377M26	IDCTR, 8.7nH
L103	2409377M31	IDCTR, 30nH
L110	2413926K27	IDCTR, 220nH
L120	2413926K27	IDCTR, 220nH
L121	2462587V25	IDCTR, 18nH
L130	2460591M27	IDCTR, 22.69nH
L131	2460591M32	IDCTR, 27.42nH
L132	2460591M27	IDCTR, 22.69nH
L140	2113740F65	CAP, 390pF
L141	2460591M27	IDCTR, 22.69nH
L211	2413926K30	IDCTR, 390nH
L251	2413926N28	IDCTR, 220nH
L252	2413926N17	IDCTR, 27nH
L254	2484562T11	IDCTR, 12.5nH
L255	2413926N28	IDCTR, 220nH
L262	2413926N17	IDCTR, 27nH
L264	2484562T11	IDCTR, 12.5nH
L265	2413926N28	IDCTR, 220nH
L270	2413926N28	IDCTR, 220nH
L271	Not_Placed	IDCTR, 220nH
L272	2413926N28	IDCTR, 220nH
L276	2413926N17	IDCTR, 27nH
L281	2413926N18	IDCTR, 33nH
L282	2413926N14	IDCTR, 15nH
L283	Not_Placed	IDCTR, 22nH
L291	2413926N10	IDCTR, 6.8nH
L292	2413926N14	IDCTR, 15nH
L471	2413926K30	IDCTR, 390nH
M140	0286427Z01	ANTENNA_NUT
Q21	4802247J01	BFS505
Q22	4805723X02	UMT1
Q51	4802197J95	PBR941
Q70	4880214G02	MMBT3904
Q100	4885593U03	BFG540W
Q150	4880214G02	MMBT3904
Q170	4809939C34	EMB10
Q171	4880048M01	DTC144EKA
Q280	4802245J95	BFS540
Q311	4809579E18	TP0101T
Q312	4809579E18	TP0101T
Q313	4802245J54	UMG5
Q402	4880048M01	DTC144EKA
Q403	4813824A17	MMBT3906
Q410	4802245J54	UMG5
Q440	5180159R01	IMX1
Q470	4805723X02	UMT1
Q471	4802245J54	UMG5
Q472	4805723X02	UMT1
Q481	Not_Placed	MMBT3906
Q482	Not_Placed	MMBT3904
Q490	4802245J54	UMG5
Q493	4809579E18	TP0101T
Q494	4802245J54	UMG5
Q520	5180159R01	IMX1
R20	0662057M92	RES, 5.6K
R21	0662057M47	RES, 75
R22	0662057M92	RES, 5.6K
R23	0662057N09	RES, 27K
R24	0662057M76	RES, 1.2K
R25	0662057M92	RES, 5.6K
R40	0662057M74	RES, 1K

Circuit Ref	Motorola Part No.	Description
R51	0662057M43	RES, 51
R52	0662057N01	RES, 12K
R53	0662057N11	RES, 33K
R54	0662057M91	RES, 5.1K
R55	0662057M62	RES, 330
R57	0662057M90	RES, 4.7K
R60	0662057M83	RES, 2.4K
R61	0662057N23	RES, 100K
R62	0662057M86	RES, 3.3K
R63	0662057N13	RES, 39K
R64	0662057N06	RES, 20K
R65	0662057N13	RES, 39K
R66	0662057N06	RES, 20K
R67	0662057N06	RES, 20K
R72	0662057M64	RES, 390
R73	0662057M80	RES, 1.8K
R74	0662057M76	RES, 1.2K
R75	0662057N01	RES, 12K
R76	0662057V04	RES, 12K
R77	0662057U99	RES, 8.2K
R78	0662057M70	RES, 680
R80	0662057M91	RES, 5.1K
R81	0662057M74	RES, 1K
R82	Not_Placed	RES, 0
R90	0662057M43	RES, 51
R91	0662057M79	RES, 1.6K
R100	0662057M72	RES, 820
R101	0662057M20	RES, 5.6
R102	0662057M72	RES, 820
R103	0662057M85	RES, 3K
R104	0662057A07	RES, 18
R105	0662057M84	RES, 2.7K
R106	0662057M90	RES, 4.7K
R107	Not_Placed	RES, 300
R110	0662057M67	RES, 510
R111	0662057M80	RES, 1.8K
R120	0662057C55	RES, 150
R121	0662057C55	RES, 150
R150	0680539Z01	RES, 0.1
R151	0662057A15	RES, 39
R152	0662057V27	RES, 100K
R153	0662057V27	RES, 100K
R154	0662057V27	RES, 100K
R155	0662057V27	RES, 100K
R156	0662057M62	RES, 330
R157	0662057M82	RES, 2.2K
R158	0662057M91	RES, 5.1K
R159	0662057B47	RES, 0
R162	0662057M98	RES, 10K
R202	0662057N27	RES, 150K
R205	0662057M50	RES, 100
R206	Not_Placed	RES, 100
R212	0662057C01	RES, 0
R220	0662057M34	RES, 22
R221	0662057M34	RES, 22
R223	0662057M50	RES, 100
R227	0662057N13	RES, 39K
R230	0662057N08	RES, 24K
R243	0662057M72	RES, 820
R244	0662057M43	RES, 51
R245	0662057M78	RES, 1.5K
R246	0662057N23	RES, 100K
R247	0662057N07	RES, 22K
R253	0662057M38	RES, 33
R254	0662057M50	RES, 100
R255	0662057U91	RES, 3.9K
R261	0662057N07	RES, 22K
R262	0662057M94	RES, 6.8K
R263	0662057M38	RES, 33
R264	0662057M50	RES, 100
R271	0662057M90	RES, 4.7K
R272	0662057M92	RES, 5.6K
R273	0662057M62	RES, 330
R274	0662057M38	RES, 33
R275	0662057M50	RES, 100
R276	Not_Placed	RES, 1K
R277	0662057B47	RES, 0
R280	0662057M90	RES, 4.7K
R281	0662057M96	RES, 8.2K
R282	0662057M73	RES, 910
R283	0662057M53	RES, 130
R284	0662057M62	RES, 330
R285	0662057M01	RES, 0
R310	0662057N23	RES, 100K
R311	0662057N23	RES, 100K
R312	0662057N06	RES, 20K
R313	0662057M98	RES, 10K
R320	0662057V43	RES, 330K
R321	0662057V35	RES, 200K
R322	0662057N23	RES, 100K
R400	Not_Placed	RES, 100K
R410	0662057M98	RES, 10K
R411	0662057M72	RES, 820
R412	0662057N23	RES, 100K
R413	0662057N23	RES, 100K
R414	0662057N11	RES, 33K
R415	0662057N11	RES, 33K
R416	0662057N06	RES, 20K
R417	0662057M98	RES, 10K
R418	0662057N23	RES, 100K
R419	0662057M90	RES, 4.7K
R420	0662057V35	RES, 200K
R421	0662057V27	RES, 100K
R422	0662057N23	RES, 100K
R423	0662057N23	RES, 100K
R424	0662057V35	RES, 200K
R425	0662057V27	RES, 100K
R430	0662057N23	RES, 100K
R431	Not_Placed	RES, 100K
R432	0662057M01	RES, 0
R433	0662057N23	RES, 100K
R434	Not_Placed	RES, 100K
R440	0662057M90	RES, 4.7K
R441	0662057M90	RES, 4.7K
R442	0662057A33	RES, 220
R443	0662057A27	RES, 120
R445	0662057M90	RES, 4.7K
R446	0662057M98	RES, 10K
R451	0662057N15	RES, 47K
R460	0662057N08	RES, 24K
R462	0662057N08	RES, 24K
R463	0662057N08	RES, 24K
R464	0662057N10	RES, 30K
R469	0662057M26	RES, 10
R470	0662057M82	RES, 2.2K
R471	0662057M82	RES, 2.2K
R472	0662057M70	RES, 680
R473	0662057M70	RES, 680
R474	0662057A37	RES, 330
R475	0662057N29	RES, 180K
R476	0662057N23	RES, 100K
R477	0662057M82	RES, 2.2K
R478	0662057M82	RES, 2.2K
R479	0662057N23	RES, 100K
R480	0662057B47	RES, 0
R481	Not_Placed	RES, 100K
R482	Not_Placed	RES, 330K
R483	Not_Placed	RES, 150K
R484	Not_Placed	RES, 2.2K
R485	Not_Placed	RES, 100K
R486	Not_Placed	RES, 100K
R487	0662057M01	RES, 0
R488	0662057N35	RES, 330K
R489	Not_Placed	RES, 91K
R490	Not_Placed	RES, 2.2K
R491	0662057M01	RES, 0
R492	0662057N08	RES, 24K
R493	0662057N35	RES, 330K
R494	0662057V43	RES, 330K
R495	0662057M92	RES, 5.6K
R496	Not_Placed	RES, 10K
R497	Not_Placed	RES, 1MEG
R498	Not_Placed	RES, 47K
R499	Not_Placed	RES, 270K
R501	0662057M50	RES, 100
R502	0662057M50	RES, 100
R503	0662057M50	RES, 100
R504	0662057M50	RES, 100
R505	0662057M50	RES, 100
R506	0662057M50	RES, 100
R507	0662057M50	RES, 100
R508	0662057N23	RES, 100K
R509	0662057N23	RES, 100K
R510	0662057N35	RES, 330K
R511	0662057N23	RES, 100K
R512	0662057N27	RES, 150K
R513	0662057N23	RES, 100K
R514	0662057N23	RES, 100K
R515	0662057M01	RES, 0
R516	Not_Placed	RES, 0
R517	Not_Placed	RES, 0
R518	0662057N31	RES, 220K
R519	0662057N23	RES, 100K
R520	0662057N23	RES, 100K
R521	Not_Placed	RES, 100K
R522	0662057N23	RES, 100K
R523	0662057M98	RES, 10K
S440	4080710Z22	switch, rotary, 16-channel select
	or 4080710Z13	switch rotary, 4-channel select
S441	4070354A01	SWITCH
S442	4070354A01	SWITCH
S443	4070354A01	SWITCH
S444	1880619Z02	SWITCH
SH1	2686421Z01	SHIELD
SH40	2686419Z01	SHIELD
SH50	2686423Z01	SHIELD
SH52	2686424Z01	SHIELD
SH100	2686418Z01	SHIELD
SH200	2686424Z01	SHIELD
SH201	2686423Z01	SHIELD
SH250	2686425Z01	SHIELD
SH251	2686425Z01	SHIELD
SH253	2686422Z01	SHIELD
SH400	2686420Z01	SHIELD
SH401	2686420Z01	SHIELD
T41	2580541Z02	XFMR
T42	2580541Z02	XFMR
U51	5186144B01	SA616
U52	5109522E10	TC7W04F
U110	0186438Z03	RA07M4047M_UHF
U150	5113818A01	LM2904
U151	2484657R01	57R01

Circuit Ref	Motorola Part No.	Description
U201*	5185963A27	63A27
U251	5105750U54	50U54
U310	5102478J01	TK71750S
U320	5185963A55	LP2986
U330	5102479J01	TK71730S
U401*	5102226J56	MC68HC11FL0
U402*	5102463J64	X25128-2.7
U403	Not_Placed	SRM2B256
U404*	5102480J01	AT49LV001N_70VI
U451	5185130C53	30C53
U480	Not_Placed	LM2904
U490	5108858K99	TDA8541
U510	5113818A01	LM2904
U511	4802245J54	UMG5
VR110	4813830A86	MM3Z3V9T1
VR301	4813830A33	MMBZ5250B
VR302	4813830A33	MMBZ5250B
VR471	4813830A18	MMBZ5235B
VR472	4813830A09	MMBZ5226B
VR473	4813830A33	MMBZ5250B
VR474	4813830A33	MMBZ5250B
VR475	4880140L20	MMBZ5245B
Y51	4802245J84	TSS2_44_395MHZ
Y70	9186145B02	45B02
Y201*	4880114R06	14R06
Y202	Not_Placed	45J68

* Motorola Depot Servicing only

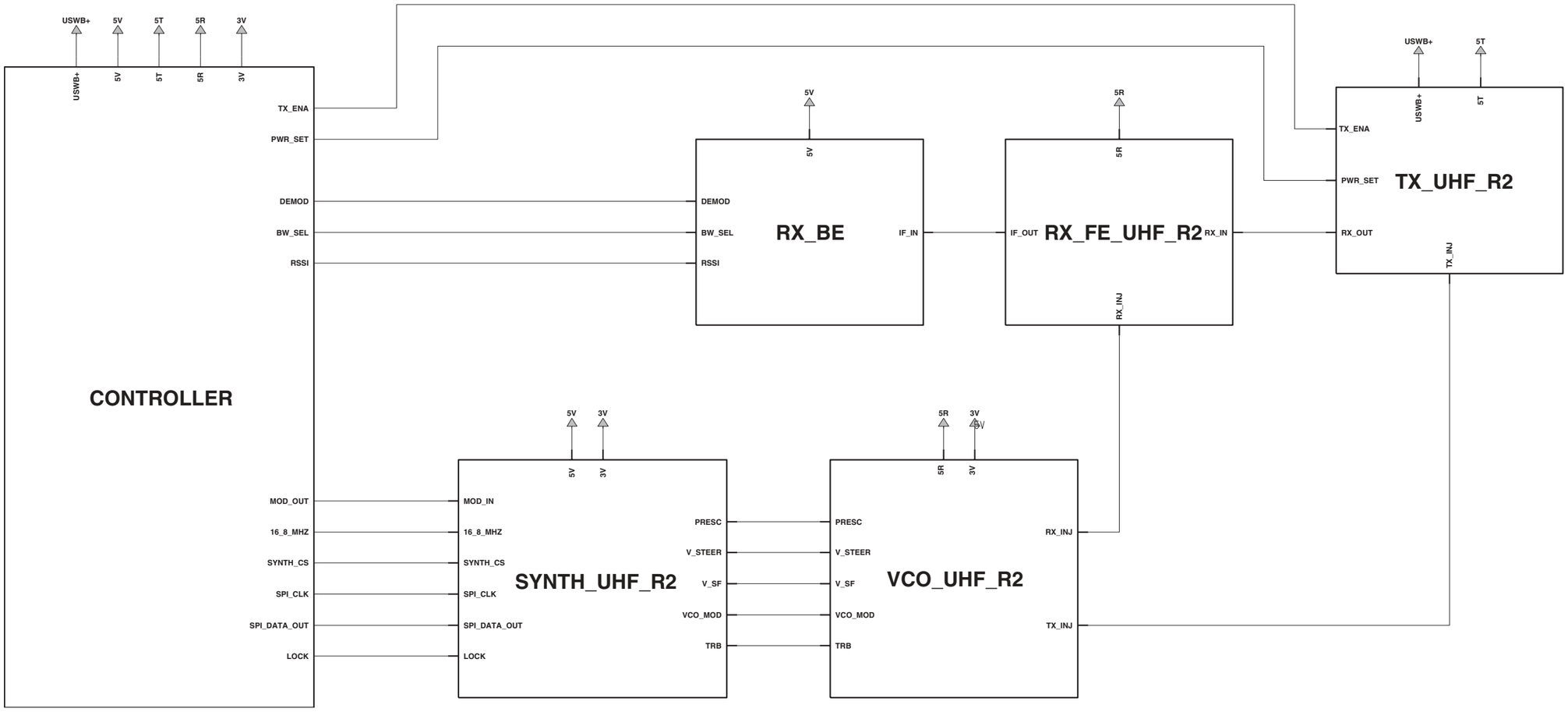


Figure 12-15. UHF (438-470 MHz) Radio Circuit Block Diagram (8486348Z09-A)

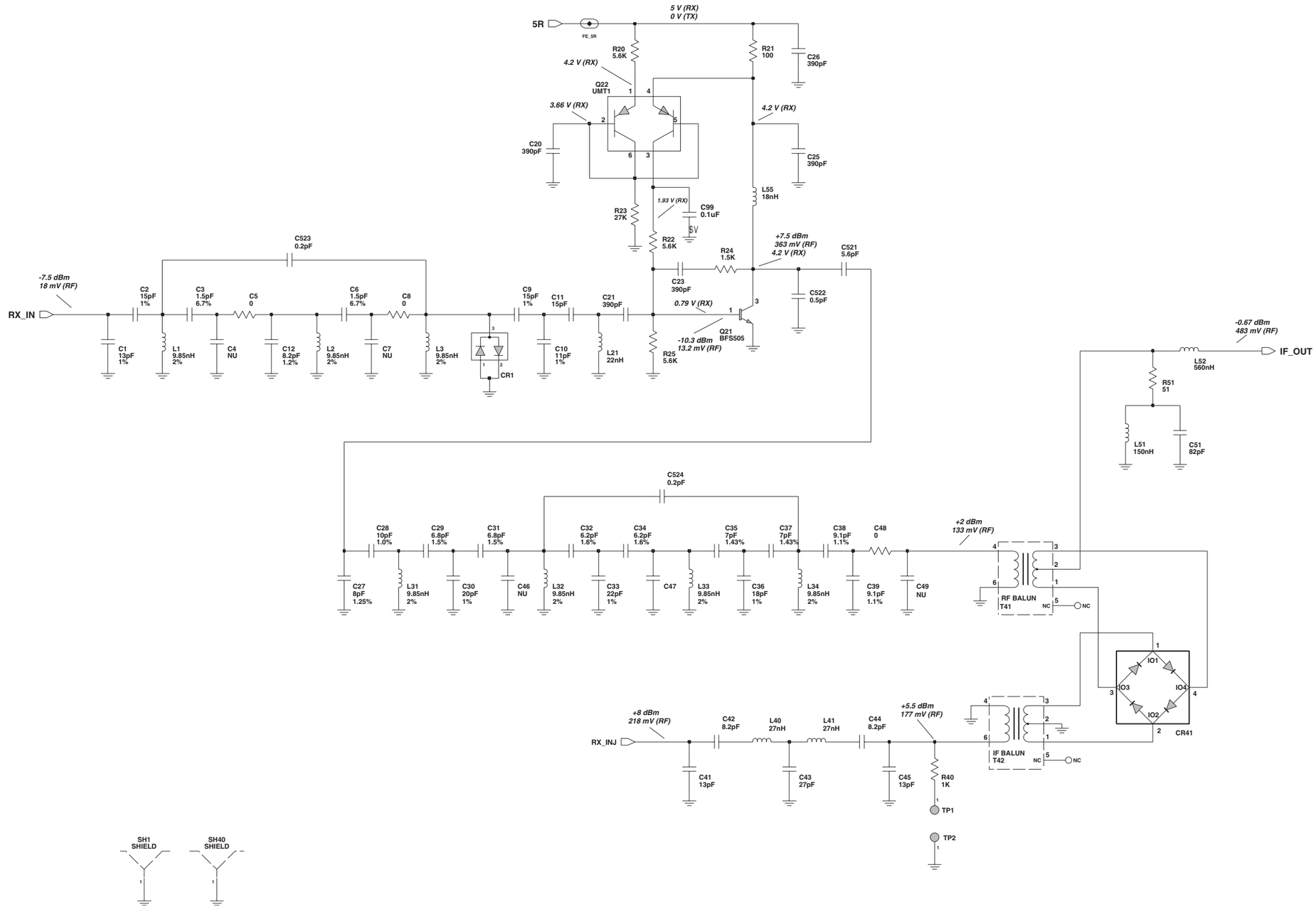


Figure 12-16. UHF (438-470 MHz) Receiver Front End Schematic Diagram (8486348Z09-A)

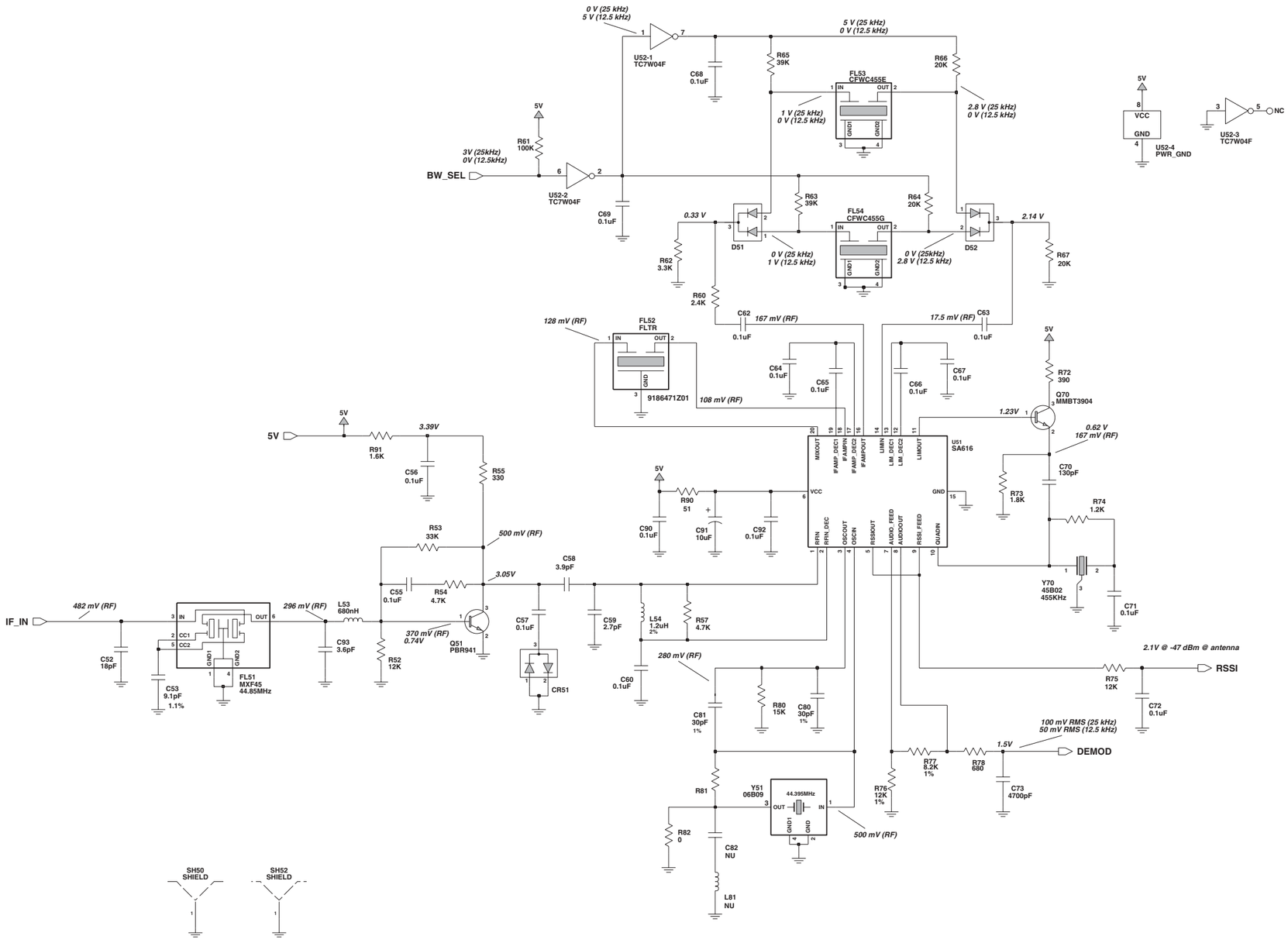


Figure 12-17. UHF (438-470 MHz) Receiver Back End Schematic Diagram (8486348Z09-A)

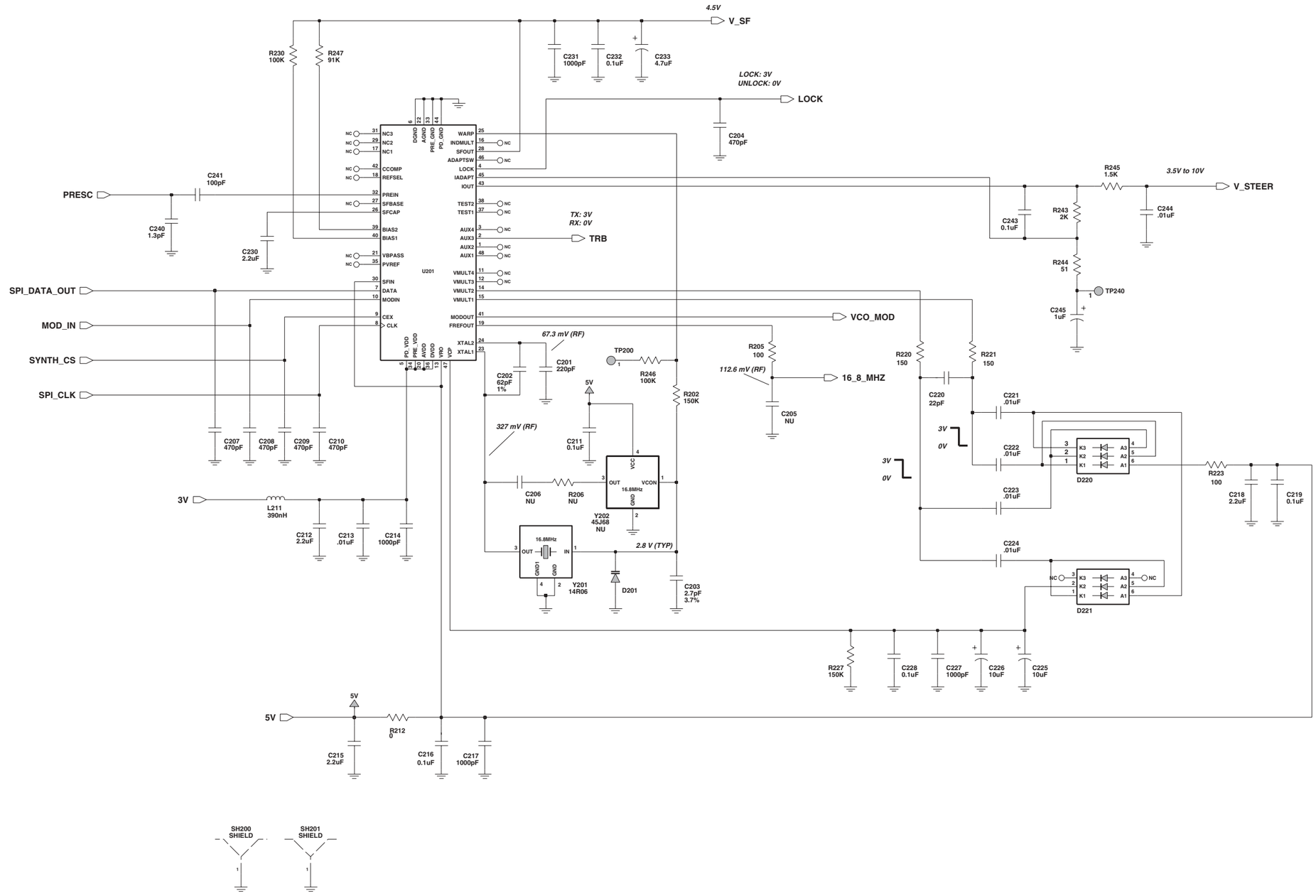


Figure 12-18. UHF (438-470 MHz) Synthesizer Schematic Diagram (8486348Z09-A)

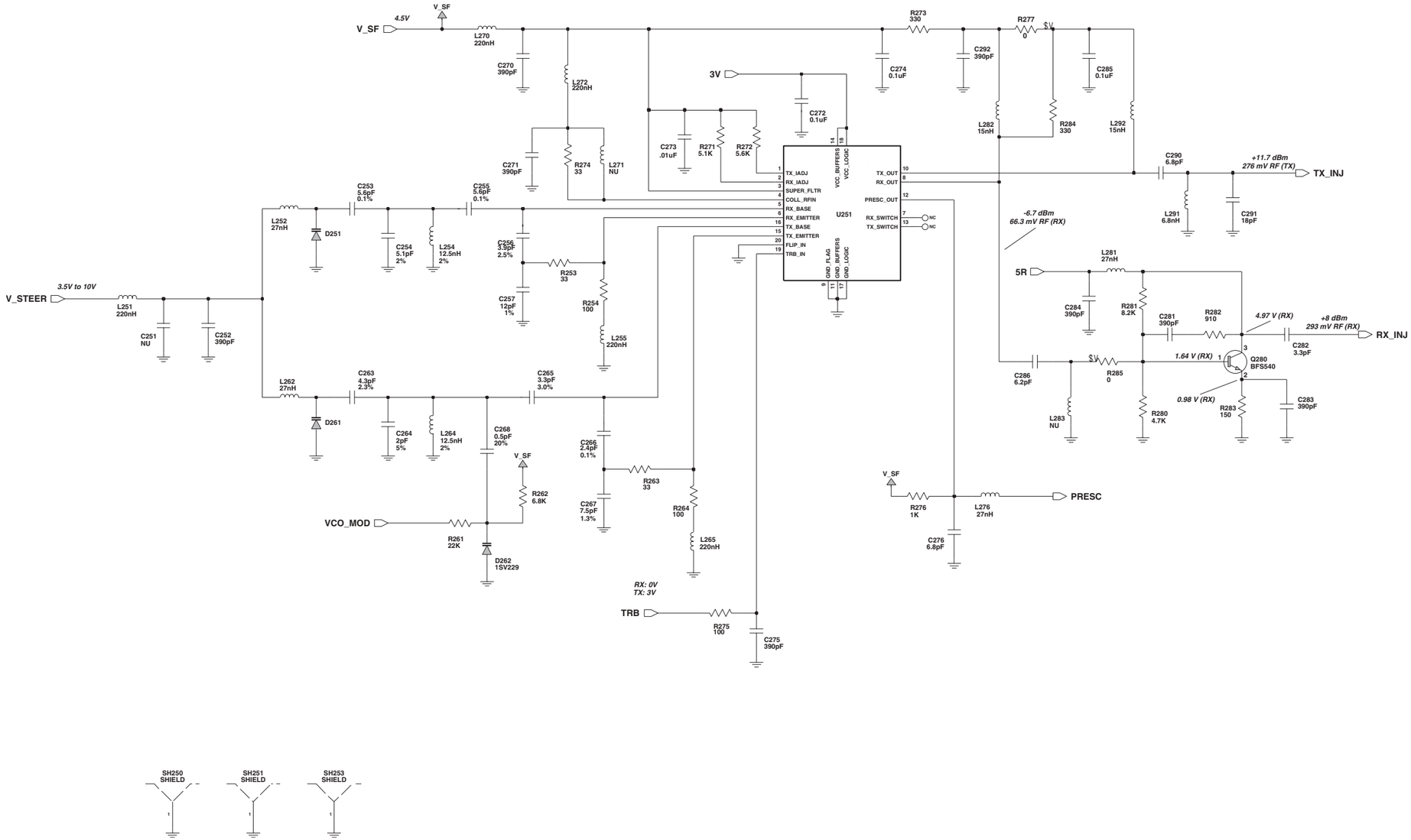


Figure 12-19. UHF (438-470 MHz) Voltage Controlled Oscillator Schematic Diagram (8486348Z09-A)

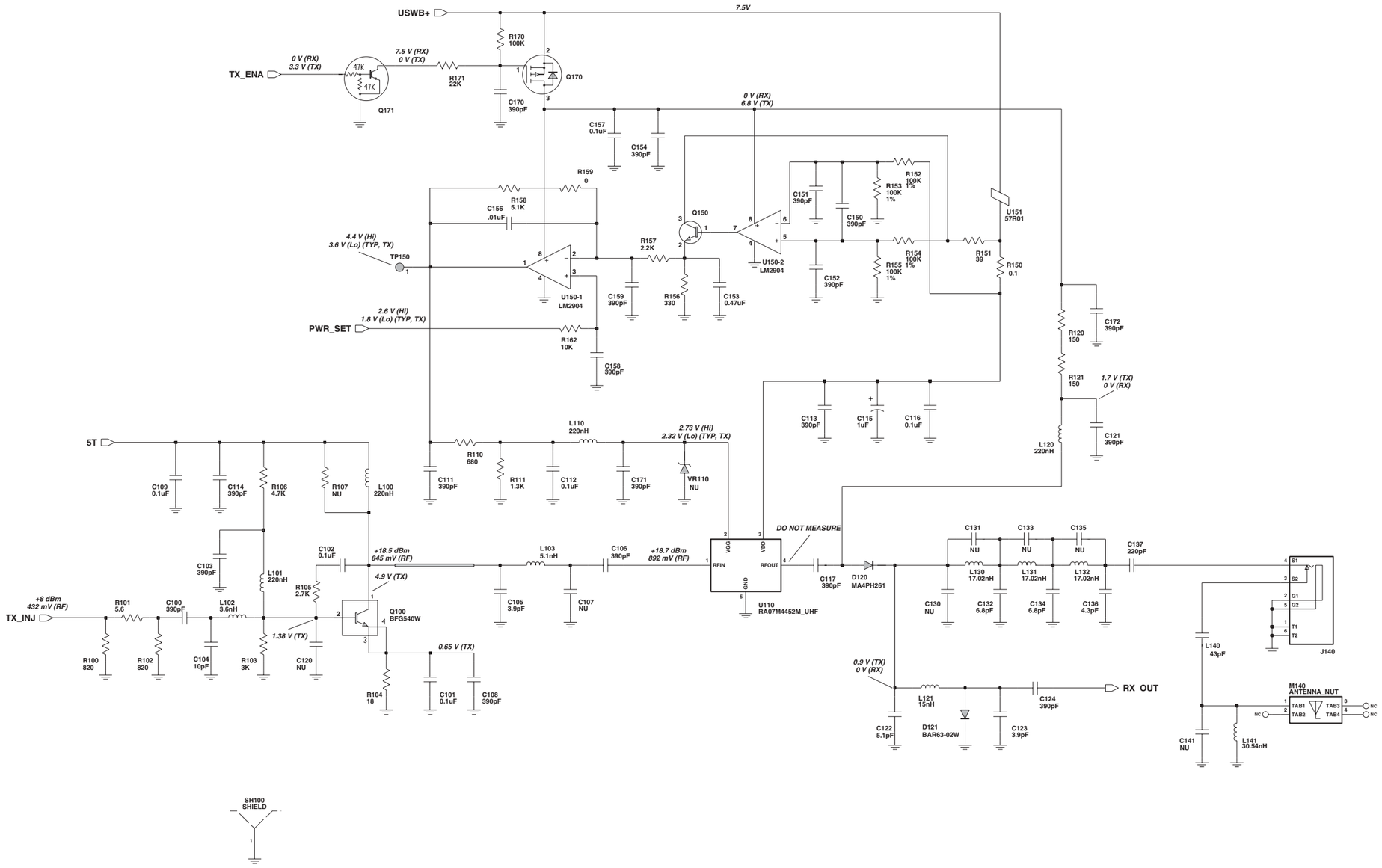


Figure 12-20. UHF (438-470 MHz) Transmitter and Power Control Schematic Diagram (8486348Z09-A)

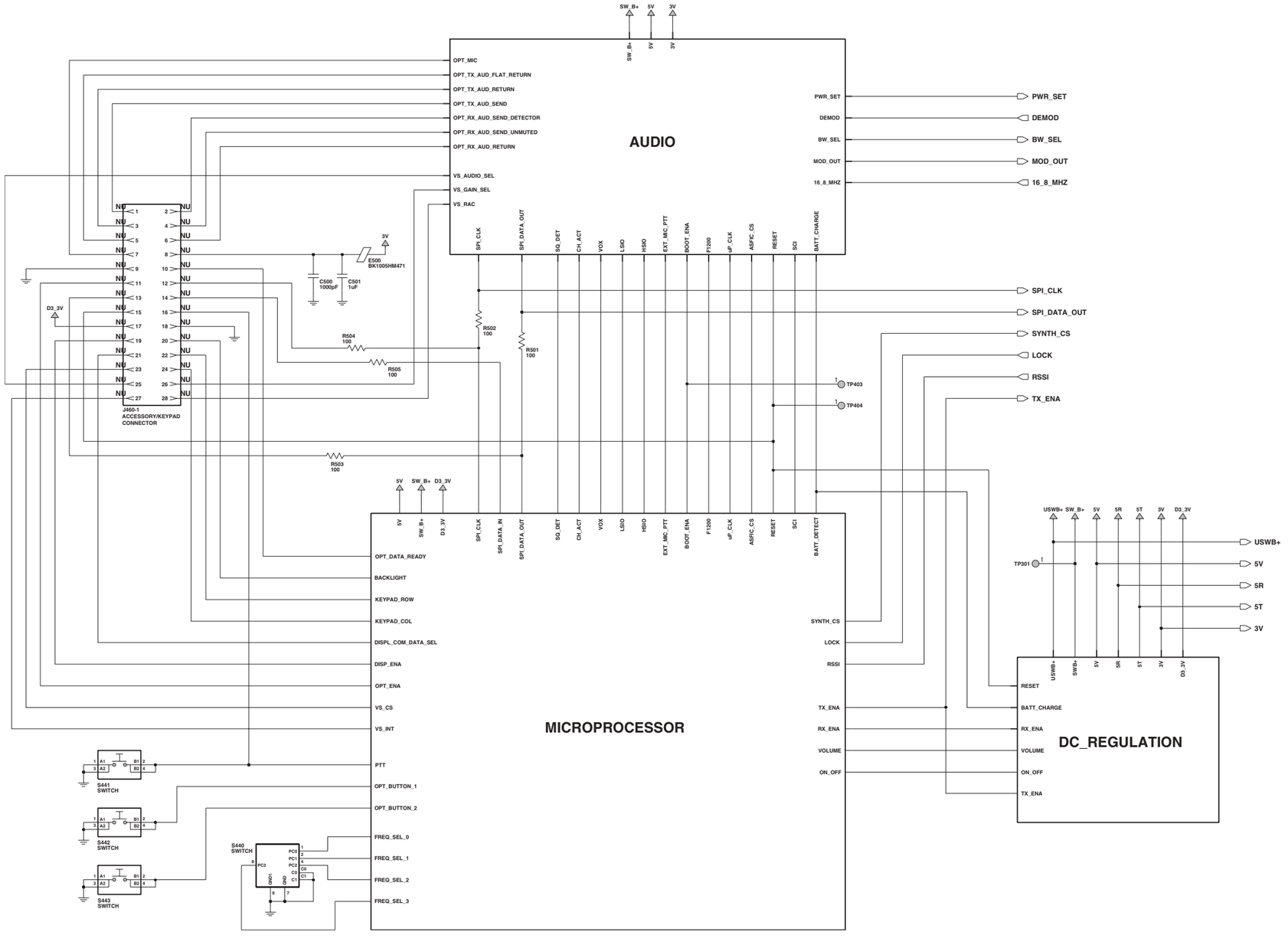


Figure 12-21. UHF (438-470 MHz) Controller Interconnect Schematic Diagram (8486348Z09-A)

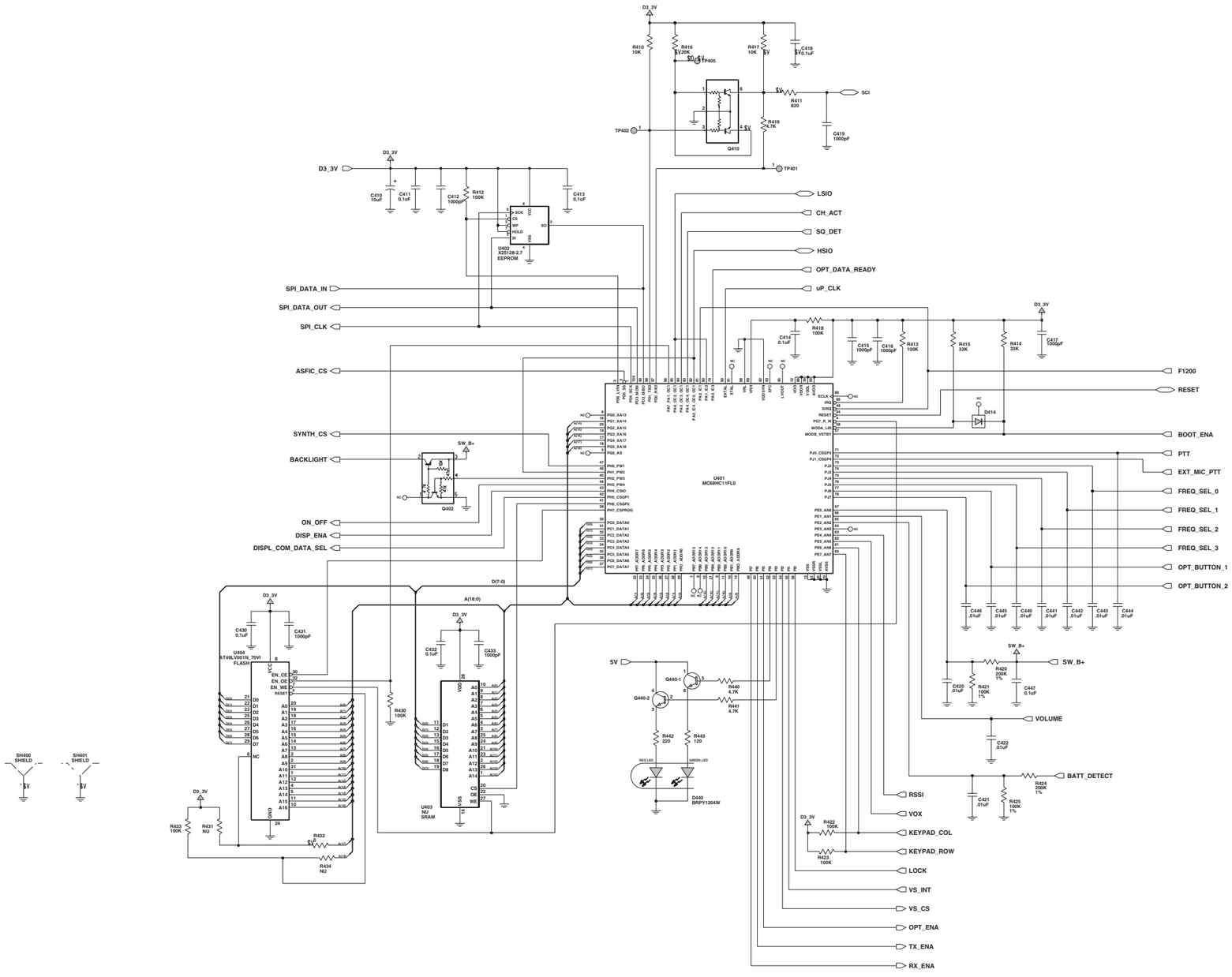


Figure 12-22. UHF (438-470 MHz) Microprocessor Circuitry Schematic Diagram (8486348Z09-A)

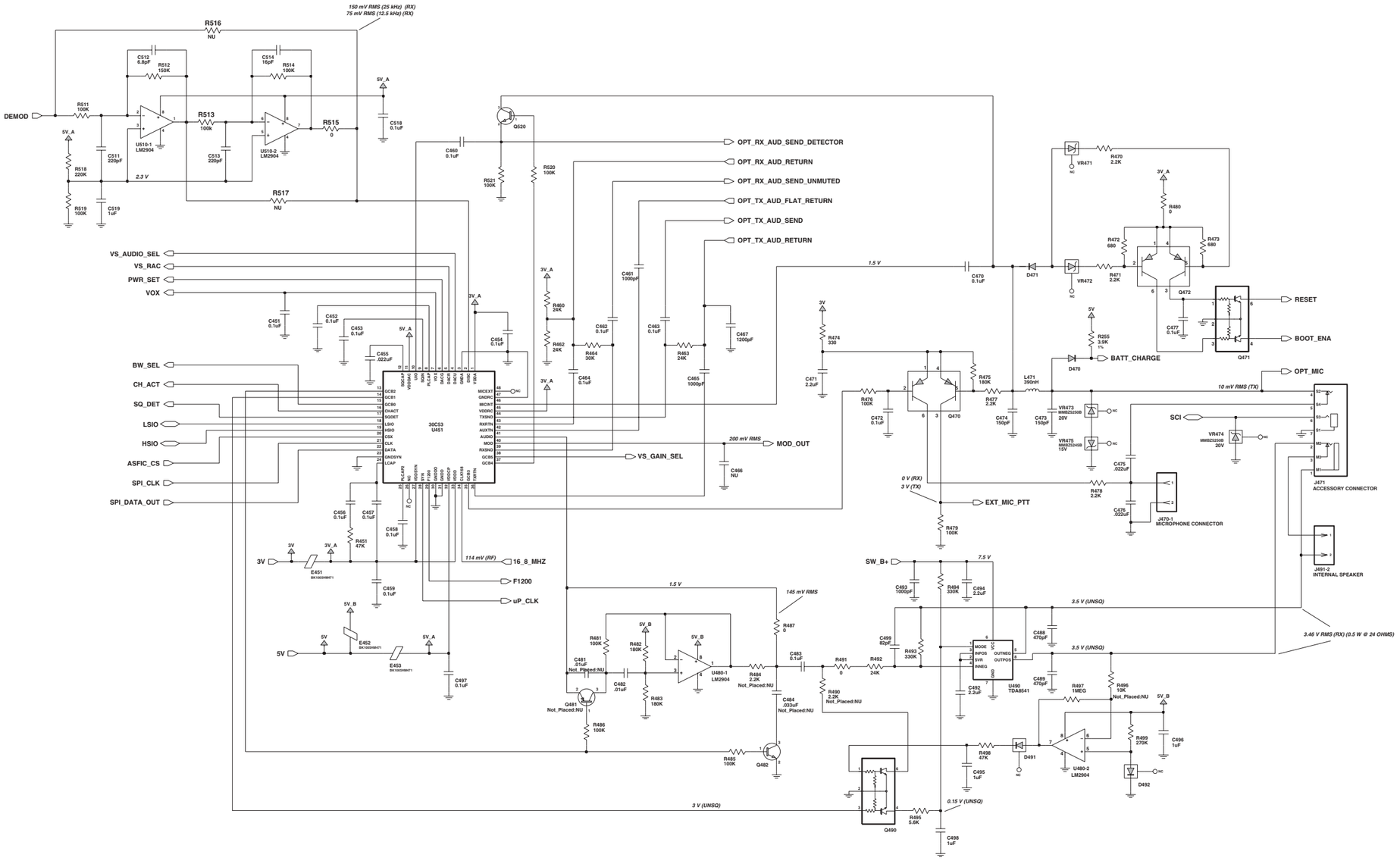


Figure 12-23. UHF (438-470 MHz) Audio Circuitry Schematic Diagram (8486348Z09-A)

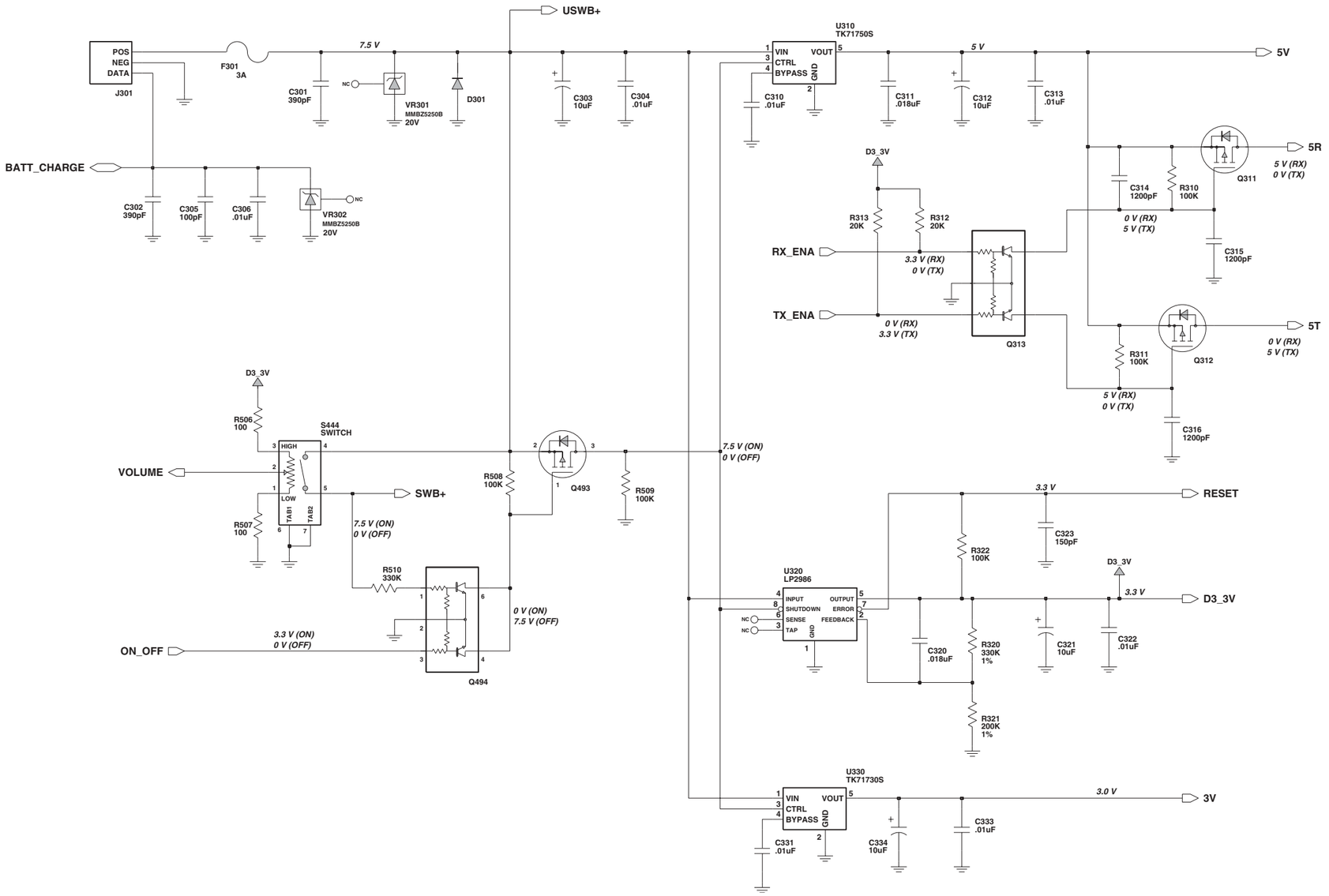


Figure 12-24. UHF (438-470 MHz) DC Regulation Schematic Diagram (8486348Z09-A)

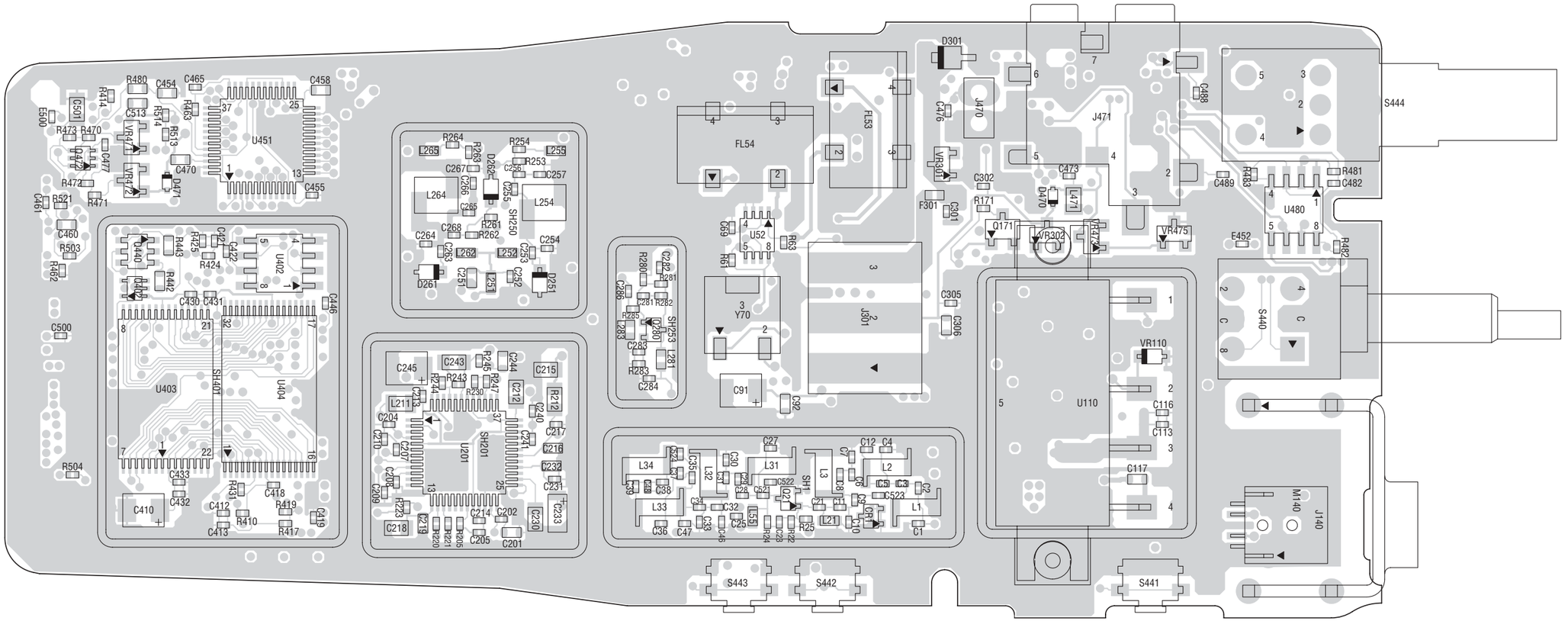


Figure 12-25. UHF (438-470 MHz) Board Component Side View (8486348Z09-A)

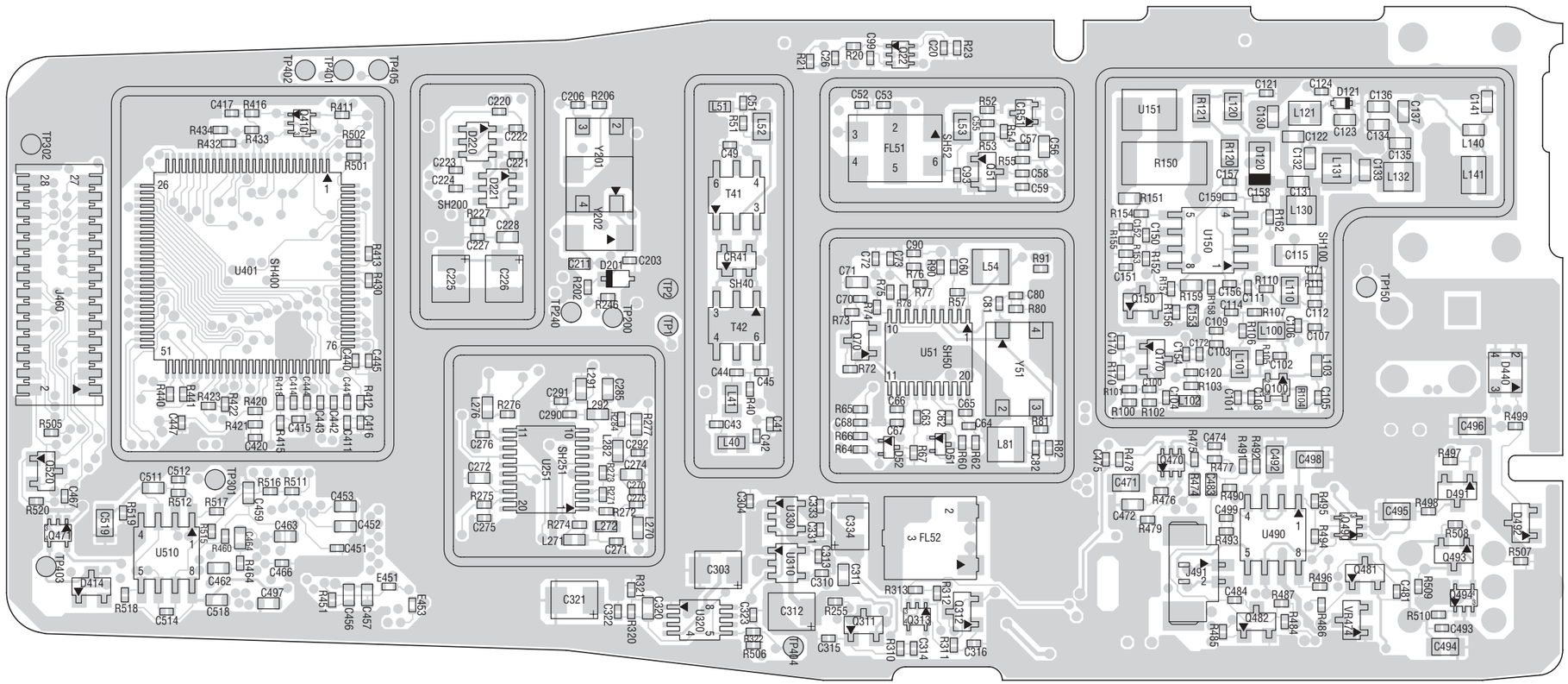


Figure 12-26. UHF (438-470 MHz) Board Solder Side View (8486348Z09-A)

UHF (438-470 MHz) Radio Parts List (8486348Z09-A)

Circuit Ref	Motorola Part No.	Description
C1	2109445U36	13 pF
C2	2109445U37	15 pF
C3	2109445U07	1.5 pF
C4		not used
C5	0662057M01	0
C6	2109445U07	1.5 pF
C7		not used
C8	0662057M01	0
C9	2109445U37	15 pF
C10	2109445U34	11 pF
C11	2113743N30	15 pF
C12	2109445U25	8.2 pF
C20	2113743L07	390 pF
C21	2113743L07	390 pF
C23	2113743L07	390 pF
C25	2113743L07	390 pF
C26	2113743L07	390 pF
C27	2109445U32	8 pF
C28	2109445U27	10 pF
C29	2109445U23	6.8 pF
C30	2109445U40	20 pF
C31	2109445U23	6.8 pF
C32	2109445U22	6.2 pF
C33	2109445U41	22 pF
C34	2109445U22	6.2 pF
C35	2109445U31	7 pF
C36	2109445U39	18 pF
C37	2109445U31	7 pF
C38	2109445U26	9.1 pF
C39	2109445U26	9.1 pF
C41	2113743N29	13 pF
C42	2113743N24	8.2 pF
C43	2109445U43	27 pF
C44	2113743N24	8.2 pF
C45	2113743N29	13 pF
C46		not used
C47		not used
C48	0662057M01	jumper
C49		not used
C51	2113743N48	82 pF
C52	2113743N32	18 pF
C53	2109445U26	9.1 pF
C55	2113743M24	0.1 uF
C56	2113743E20	0.1 uF
C57	2113743M24	0.1 uF
C58	2113743N16	3.9 pF
C59	2113743N12	2.7 pF
C60	2113743M24	0.1 uF
C62	2113743M24	0.1 uF
C63	2113743M24	0.1 uF
C64	2113743M24	0.1 uF
C65	2113743M24	0.1 uF
C66	2113743M24	0.1 uF
C67	2113743M24	0.1 uF
C68	2113743M24	0.1 uF
C69	2113743M24	0.1 uF
C70	2113743N53	130 pF
C71	2113743E20	0.1 uF
C72	2113743M24	0.1 uF
C73	2113743L33	4700 pF
C80	2109445U44	30 pF
C81	2109445U44	30 pF
C82		not used
C90	2113743M24	0.1 uF
C91	2311049A57	10 uF
C92	2113743E20	0.1 uF
C93	2113743N15	3.6 pF
C99	2113743M24	0.1 uF
C100	2113743L07	390 pF
C101	2113743M24	0.1 uF
C102	2113743M24	0.1 uF
C103	2113743L07	390 pF
C104	2113743N26	10 pF
C105	2113743N16	3.9 pF
C106	2113743L07	390 pF
C107		not used
C108	2113743L07	390 pF
C109	2113743M24	0.1 uF
C111	2113743L07	390 pF
C112	2113743M24	0.1 uF
C113	2113743L07	390 pF
C114	2113743L07	390 pF
C115	2311049A07	1 uF
C116	2113743M24	0.1 uF
C117	2113740F65	390 pF
C120		not used
C121	2113743L07	390 pF
C122	2113740F20	5.1 pF
C123	2113740F17	3.9 pF
C124	2113743L07	390 pF
C130		not used
C131		not used
C132	2113740F23	6.8 pF
C133		not used
C134	2113740F23	6.8 pF
C135		not used
C136	2113740F18	4.3 pF
C137	2113740F59	220 pF
C141		not used
C150	2113743L07	390 pF
C151	2113743L07	390 pF
C152	2113743L07	390 pF
C153	2113743K18	0.47 uF
C154	2113743L07	390 pF
C156	2113743L41	.01 uF
C157	2113743M24	0.1 uF
C158	2113743L07	390 pF
C159	2113743L07	390 pF
C170	2113743L07	390 pF
C171	2113743L07	390 pF
C172	2113743L07	390 pF
C201	2113740F59	220 pF
C202	2109445U52	62 pF
C203	2109445U13	2.7 pF
C204	2113743L09	470 pF
C205		not used
C206		not used
C207	2113743L09	470 pF
C208	2113743L09	470 pF
C209	2113743L09	470 pF
C210	2113743L09	470 pF
C211	2113743E20	0.1 uF
C212	2113743F18	2.2 uF
C213	2113743L41	.01 uF
C214	2113743L17	1000 pF
C215	2113743F18	2.2 uF
C216	2113743E20	0.1 uF
C217	2113743L17	1000 pF
C218	2113743F18	2.2 uF
C219	2113743E20	0.1 uF
C220	2113743N34	22 pF
C221	2113743L41	.01 uF
C222	2113743L41	.01 uF
C223	2113743L41	.01 uF
C224	2113743L41	.01 uF
C225	2311049A57	10 uF
C226	2311049A57	10 uF
C227	2113743L17	1000 pF
C228	2113743E20	0.1 uF
C230	2113743F18	2.2 uF
C231	2113743L17	1000 pF
C232	2113743E20	0.1 uF
C233	2311049A56	4.7 uF
C240	2113743N06	1.3 pF
C241	2113743N50	100 pF
C243	2113741M69	0.1 uF
C244	2113741F49	.01 uF
C245	2311049A08	1 uF
C251		not used
C252	2113743L07	390 pF
C253	2109445U21	5.6 pF
C254	2109445U20	5.1 pF
C255	2109445U21	5.6 pF
C256	2109445U17	3.9 pF
C257	2109445U35	12 pF
C263	2109445U18	4.3 pF
C264	2109445U10	2 pF
C265	2109445U15	3.3 pF
C266	2109445U12	2.4 pF
C267	2109445U24	7.5 pF
C268	2109445U01	0.5 pF
C270	2113743L07	390 pF
C271	2113743L07	390 pF
C272	2113743E20	0.1 uF
C273	2113743L41	.01 uF
C274	2113743E20	0.1 uF
C275	2113743L07	390 pF
C276	2113743N22	6.8 pF
C281	2113743L07	390 pF
C282	2113743N14	3.3 pF
C283	2113743L07	390 pF
C284	2113743L07	390 pF
C285	2113743E20	0.1 uF
C286	2113743N21	6.2 pF
C290	2113743N22	6.8 pF
C291	2113743N32	18 pF
C292	2113743L07	390 pF
C301	2113743L07	390 pF
C302	2113743L07	390 pF
C303	2311049A57	10 uF
C304	2113743L41	.01 uF
C305	2113743N50	100 pF
C306	2113741F49	.01 uF
C310	2113743L41	.01 uF
C311	2113743E05	.018 uF
C312	2311049A57	10 uF
C313	2113743L41	.01 uF
C314	2113743L19	1200 pF
C315	2113743L19	1200 pF
C316	2113743L19	1200 pF
C320	2113743E05	.018 uF
C321	2311049A57	10 uF
C322	2113743L41	.01 uF
C323	2113743N54	150 pF
C331	2113743L41	.01 uF
C333	2113743L41	.01 uF
C334	2311049A57	10 uF
C410	2311049A57	10 uF
C411	2113743M24	0.1 uF
C412	2113743L17	1000 pF
C413	2113743M24	0.1 uF
C414	2113743M24	0.1 uF
C415	2113743L17	1000 pF

Circuit Ref	Motorola Part No.	Description
C416	2113743L17	1000 pF
C417	2113743L17	1000 pF
C418	2113743M24	0.1 uF
C419	2113743L17	1000 pF
C420	2113743L41	.01 uF
C421	2113743L41	.01 uF
C422	2113743L41	.01 uF
C430	2113743M24	0.1 uF
C431	2113743L17	1000 pF
C432	2113743M24	0.1 uF
C433	2113743L17	1000 pF
C440	2113743L41	.01 uF
C441	2113743L41	.01 uF
C442	2113743L41	.01 uF
C443	2113743L41	.01 uF
C444	2113743L41	.01 uF
C445	2113743L41	.01 uF
C446	2113743L41	.01 uF
C447	2113743M24	0.1 uF
C451	2113743M24	0.1 uF
C452	2113743E20	0.1 uF
C453	2113743E20	0.1 uF
C454	2113743E20	0.1 uF
C455	2113743L48	.022 uF
C456	2113743E20	0.1 uF
C457	2113743E20	0.1 uF
C458	2113743E20	0.1 uF
C459	2113743E20	0.1 uF
C460	2113743E20	0.1 uF
C461	2113743L17	1000 pF
C462	2113743E20	0.1 uF
C463	2113743E20	0.1 uF
C464	2113743E20	0.1 uF
C465	2113743L17	1000 pF
C466		not used
C467	2113743L19	1200 pF
C470	2113743E20	0.1 uF
C471	2113743F18	2.2 uF
C472	2113743E20	0.1 uF
C473	2113743N54	150 pF
C474	2113743N54	150 pF
C475	2113743L48	.022 uF
C476	2113743L48	.022 uF
C477	2113743M24	0.1 uF
C481		not used
C482	2113743L41	.01 uF
C483	2113743E20	0.1 uF
C484		not used
C488	2113743L09	470 pF
C489	2113743L09	470 pF
C492	2113743F18	2.2 uF

Circuit Ref	Motorola Part No.	Description
C493	2113743L17	1000 pF
C494	2113743F18	2.2 uF
C495	2113743F16	1 uF
C496	2113743F16	1 uF
C497	2113743E20	0.1 uF
C498	2113743F16	1 uF
C499	2113743N48	82 pF
C500	2113743L17	1000 pF
C501	2113743F16	1 uF
C511	2113740F59	220 pF
C512	2113743N22	6.8 pF
C513	2113740F59	220 pF
C514	2113743N31	16 pF
C518	2113743E20	0.1 uF
C519	2113743F16	1 uF
C521	2113743N20	5.6 pF
C522	2113743N01	0.5 pF
C523	PT21MTPB32	0.4 pF
C524	2186463Z01	0.2 pF
CR1	4813825A19	dual Schottky, MMBD352
CR41	4886143B01	quad ring diode, SMS3927-99
CR51	4813825A19	dual Schottky, MMBD352
D51	4802245J97	dual silicon, DAN235ETL
D52	4802245J97	dual silicon, DAN235ETL
D120	4880973Z02	silicon PIN, MA4PH261
D121	4809948D12	silicon PIN, BAR_63-02W
D201	4862824C03	varactor, 1SV232
D220	4802233J09	triple diode, IMN10
D221	4802233J09	triple diode, IMN10
D251	4862824C01	varactor, 1SV229
D261	4862824C01	varactor, 1SV229
D262	4862824C01	varactor, 1SV229
D301	4813833A19	silicon, reverse polarity, MBRM120ET3
D414	4805129M41	Schottky, MMBD501
D440	4805729G49	dual LED red/green, BRPY1204W
D470	4809924D18	Schottky, RB520S-30
D471	4809924D18	Schottky, RB520S-30
D491	4805129M41	Schottky, MMBD501
D492	4805129M41	Schottky, MMBD501
E451	2480640Z01	bead, BK1005HM471
E452	2480640Z01	bead, BK1005HM471
E453	2480640Z01	bead, BK1005HM471
E500	2480640Z01	bead, BK1005HM471
F301	6580542Z01	fuse, 3 amp
FL51	9180022M11	4-pole crystal filter, 44.85 MHz
FL52	9180468V05	4-pole ceramic filter, 455 kHz, CFU455E
FL53	9180469V05	6-pole ceramic filter, 455 kHz, CFWC455E

Circuit Ref	Motorola Part No.	Description
FL54	9180469V03	6-pole ceramic filter, 455 kHz, CFWC455G
J140	0986428Z01	connector, external antenna
J301	0986565Z01	battery contact assembly
J460		not used
J470	0985818A01	connector, 2-pin, internal mic
J471	0980683Z03	connector, 2.5 / 3.5 mm, accessories
J491	0909897T04	connector, 2-pin, internal spkr
L1	2409348J15	9.85 nH
L2	2409348J15	9.85 nH
L3	2409348J15	9.85 nH
L21	2413926N16	22 nH
L31	2409348J15	9.85 nH
L32	2409348J15	9.85 nH
L33	2409348J15	9.85 nH
L34	2409348J15	9.85 nH
L40	2413926K16	27 nH
L41	2413926K16	27 nH
L51	2413926N26	150 nH
L52	2413926K32	560 nH
L53	2413926K33	680 nH
L54	2413923A25	1.2 uH
L55	2413926N15	18 nH
L81		not used
L100	2413926K27	220 nH
L101	2413926K27	220 nH
L102	2409377M21	3.6 nH
L103	2409377M24	5.1 nH
L110	2413926K27	220 nH
L120	2413926K27	220 nH
L121	2462587V24	15 nH
L130	2460591C40	17.02 nH
L131	2460591C40	17.02 nH
L132	2460591C40	17.02 nH
L140	2113740F42	43 pF
L141	2479990M01	30.54 nH
L211	2413926K30	390 nH
L251	2413926N28	220 nH
L252	2413926N17	27 nH
L254	2484562T11	12.5 nH
L255	2413926N28	220 nH
L262	2413926N17	27 nH
L264	2484562T11	12.5 nH
L265	2413926N28	220 nH
L270	2413926N28	220 nH
L271		not used
L272	2413926N28	220 nH
L276	2413926N17	27 nH
L281	2413926N17	27 nH
L282	2413926N14	15 nH

Circuit Ref	Motorola Part No.	Description
L283		not used
L291	2413926N10	6.8 nH
L292	2413926N14	15 nH
L471	2413926K30	390 nH
M140	0286427Z01	antenna nut
Q21	4802247J01	silicon NPN, BFS505
Q22	4805723X02	dual silicon PNP, UMT1
Q51	4802197J95	silicon NPN, PBR941
Q70	4880214G02	silicon NPN, MMBT3904
Q100	4885593U03	silicon NPN, BFG540W
Q150	4880214G02	silicon NPN, MMBT3904
Q170	4809579E18	P-channel MOSFET, TP0101T
Q171	4880048M01	digital NPN, DTC144EKA
Q280	4802245J95	silicon NPN, BFS540
Q311	4809579E18	P-channel MOSFET, TP0101T
Q312	4809579E18	P-channel MOSFET, TP0101T
Q313	4802245J54	dual digital NPN, UMG5
Q402	4809939C05	dual digital NPN/PNP, UMC5NTL
Q410	4802245J54	dual digital NPN, UMG5
Q440	5180159R01	dual NPN, IMX1
Q470	4805723X02	dual silicon PNP, UMT1
Q471	4802245J54	dual digital NPN, UMG5
Q472	4805723X02	dual silicon PNP, UMT1
Q481		not used
Q482	4813824A10	silicon NPN, MMBT3904
Q490	4802245J54	dual digital NPN, UMG5
Q493	4809579E18	P-channel MOSFET, TP0101T
Q494	4802245J54	dual digital NPN, UMG5
Q520	4813824A10	silicon NPN, MMBT3904
R20	0662057M92	5.6K
R21	0662057M50	100
R22	0662057M92	5.6K
R23	0662057N09	27K
R24	0662057M78	1.5K
R25	0662057M92	5.6K
R40	0662057M74	1K
R51	0662057M43	51
R52	0662057N01	12K
R53	0662057N11	33K
R54	0662057M90	4.7K
R55	0662057M62	330
R57	0662057M90	4.7K
R60	0662057M83	2.4K
R61	0662057N23	100K
R62	0662057M86	3.3K
R63	0662057N13	39K
R64	0662057N06	20K
R65	0662057N13	39K
R66	0662057N06	20K
R67	0662057N06	20K

Circuit Ref	Motorola Part No.	Description
R72	0662057M64	390
R73	0662057M80	1.8K
R74	0662057M76	1.2K
R75	0662057N01	12K
R76	0662057V04	12K
R77	0662057U99	8.2K
R78	0662057M70	680
R80	0662057N03	15K
R81		not used
R82	0662057M01	0
R90	0662057M43	51
R91	0662057M79	1.6K
R100	0662057M72	820
R101	0662057M20	5.6
R102	0662057M72	820
R103	0662057M85	3K
R104	0662057A07	18
R105	0662057M84	2.7K
R106	0662057M90	4.7K
R107		not used
R110	0662057M70	680
R111	0662057M77	1.3K
R120	0662057C55	150
R121	0662057C55	150
R150	0680539Z01	0.1
R151	0662057A15	39
R152	0662057V27	100K
R153	0662057V27	100K
R154	0662057V27	100K
R155	0662057V27	100K
R156	0662057M62	330
R157	0662057M82	2.2K
R158	0662057M91	5.1K
R159	0662057B47	0
R162	0662057M98	10K
R170	0662057N23	100K
R171	0662057N07	22K
R202	0662057N27	150K
R205	0662057M50	100
R206		not used
R212	0662057C01	0
R220	0662057M54	150
R221	0662057M54	150
R223	0662057M50	100
R227	0662057N27	150K
R230	0662057N23	100K
R243	0662057M81	2K
R244	0662057M43	51
R245	0662057M78	1.5K
R246	0662057N23	100K
R247	0662057N22	91K

Circuit Ref	Motorola Part No.	Description
R253	0662057M38	33
R254	0662057M50	100
R255	0662057U91	3.9K
R261	0662057N07	22K
R262	0662057M94	6.8K
R263	0662057M38	33
R264	0662057M50	100
R271	0662057M91	5.1K
R272	0662057M92	5.6K
R273	0662057M62	330
R274	0662057M38	33
R275	0662057M50	100
R276	0662057M74	1K
R277	0662057B47	0
R280	0662057M90	4.7K
R281	0662057M96	8.2K
R282	0662057M73	910
R283	0662057M54	150
R284	0662057M62	330
R285	0662057M01	0
R310	0662057N23	100K
R311	0662057N23	100K
R312	0662057N06	20K
R313	0662057N06	20K
R320	0662057V43	330K
R321	0662057V35	200K
R322	0662057N23	100K
R410	0662057M98	10K
R411	0662057M72	820
R412	0662057N23	100K
R413	0662057N23	100K
R414	0662057N11	33K
R415	0662057N11	33K
R416	0662057N06	20K
R417	0662057M98	10K
R418	0662057N23	100K
R419	0662057M90	4.7K
R420	0662057V35	200K
R421	0662057V27	100K
R422	0662057N23	100K
R423	0662057N23	100K
R424	0662057V35	200K
R425	0662057V27	100K
R430	0662057N23	100K
R431		not used
R432	0662057M01	0
R433	0662057N23	100K
R434		not used
R440	0662057M90	4.7K
R441	0662057M90	4.7K
R442	0662057A33	220

Circuit Ref	Motorola Part No.	Description
R443	0662057A27	120
R451	0662057N15	47K
R460	0662057N08	24K
R462	0662057N08	24K
R463	0662057N08	24K
R464	0662057N10	30K
R470	0662057M82	2.2K
R471	0662057M82	2.2K
R472	0662057M70	680
R473	0662057M70	680
R474	0662057A37	330
R475	0662057N29	180K
R476	0662057N23	100K
R477	0662057M82	2.2K
R478	0662057M82	2.2K
R479	0662057N23	100K
R480	0662057B47	0
R481	0662057N23	100K
R482	0662057N29	180K
R483	0662057N29	180K
R484		not used
R485	0662057N23	100K
R486	0662057N23	100K
R487	0662057M01	0
R490		not used
R491	0662057M01	0
R492	0662057N08	24K
R493	0662057N35	330K
R494	0662057V43	330K
R495	0662057M92	5.6K
R496		not used
R497	0662057N47	1MEG
R498	0662057N15	47K
R499	0662057N33	270K
R501	0662057M50	100
R502	0662057M50	100
R503	0662057M50	100
R504	0662057M50	100
R505	0662057M50	100
R506	0662057M50	100
R507	0662057M50	100
R508	0662057N23	100K
R509	0662057N23	100K
R510	0662057N35	330K
R511	0662057N23	100K
R512	0662057N27	150K
R513	0662057N23	100K
R514	0662057N23	100K
R515	0662057M01	0
R516		not used
R517		not used

Circuit Ref	Motorola Part No.	Description
R518	0662057N31	220K
R519	0662057N23	100K
R520	0662057N23	100K
R521	0662057N23	100K
S440	4080710Z22	switch, rotary, 16 channel select
	or 4080710Z13	switch, rotary, 4 channel select
S441	4070354A01	pushbutton switch, PTT
S442	4070354A01	pushbutton switch, side option (lower)
S443	4070354A01	pushbutton switch, side option (upper)
S444	1880619Z02	switch, rotary on-off, with 10K volume control
SH1	2686421Z01	shield, comp side, RF front end
SH40	2686419Z01	shield, solder side, first mixer
SH50	2686423Z01	shield, solder side, IFIC and 2nd LO crystal
SH52	2686424Z01	shield, solder side, high IF crystal filter
SH100	2686418Z01	shield, solder side, transmitter
SH200	2686424Z01	shield, solder side, synthesizer charge pump
SH201	2686423Z01	shield, com side, synthesizer
SH250	2686425Z01	shield, comp side, VCO tank circuits
SH251	2686425Z01	shield, solder side, VCOBIC
SH253	2686422Z01	shield, comp side, VCO RX injection buffer
SH400	2686420Z01	shield, solder side, microprocessor
SH401	2686420Z01	shield, comp side, memory
T41	2580541Z02	transformer, balun
T42	2580541Z02	transformer, balun
U51	5186144B01	receiver system (IFIC), SA616
U52	5109522E10	triple inverter, TC7W04F
U110	5102466J01	transmitter PA module, RA07M4452M_UHF
U150	5113818A01	dual opamp, LM2904
U151	2484657R01	bead
U201*	5185963A27	frequency synthesizer
U251	5105750U54	VCO/buffer
U310	5102478J01	5V voltage regulator, TK71750S
U320	5185963A55	adjustable voltage regulator w/ reset, LP2986
U330	5102479J01	3V voltage regulator, TK71730S

Circuit Ref	Motorola Part No.	Description
U401*	5102226J56	microprocessor, MC68HC11FL0
U402*	5102463J64	serial EEPROM 16Kx8, AT25128
U403		not used
U404*	5102480J01	Flash ROM 128Kx8, AT49LV001N_70V
U451	5185130C53	audio filter (ASFIC_cmp)
U480	5113818A01	dual opamp, LM2904
U490	5108858K99	audio power amplifier, TDA8541
U510	5113818A01	dual opamp, LM2904
VR110		not used
VR301	4813830A33	zener diode, 20V, MMBZ5250B
VR302	4813830A33	zener diode, 20V, MMBZ5250B
VR471	4813830A18	zener diode, 6.8V, MMBZ5235B
VR472	4813830A09	zener diode, 3.3V, MMBZ5226B
VR473	4813830A33	zener diode, 20V, MMBZ5250B
VR474	4813830A33	zener diode, 20V, MMBZ5250B
VR475	4880140L20	zener diode, 15V, MMBZ5245B
Y51	4880606B09	crystal, 44.395 MHz
Y70	9186145B02	ceramic discriminator, 455 kHz
Y201*	4880114R06	crystal, 16.8 MHz
Y202		not used

* Motorola Depot Servicing only

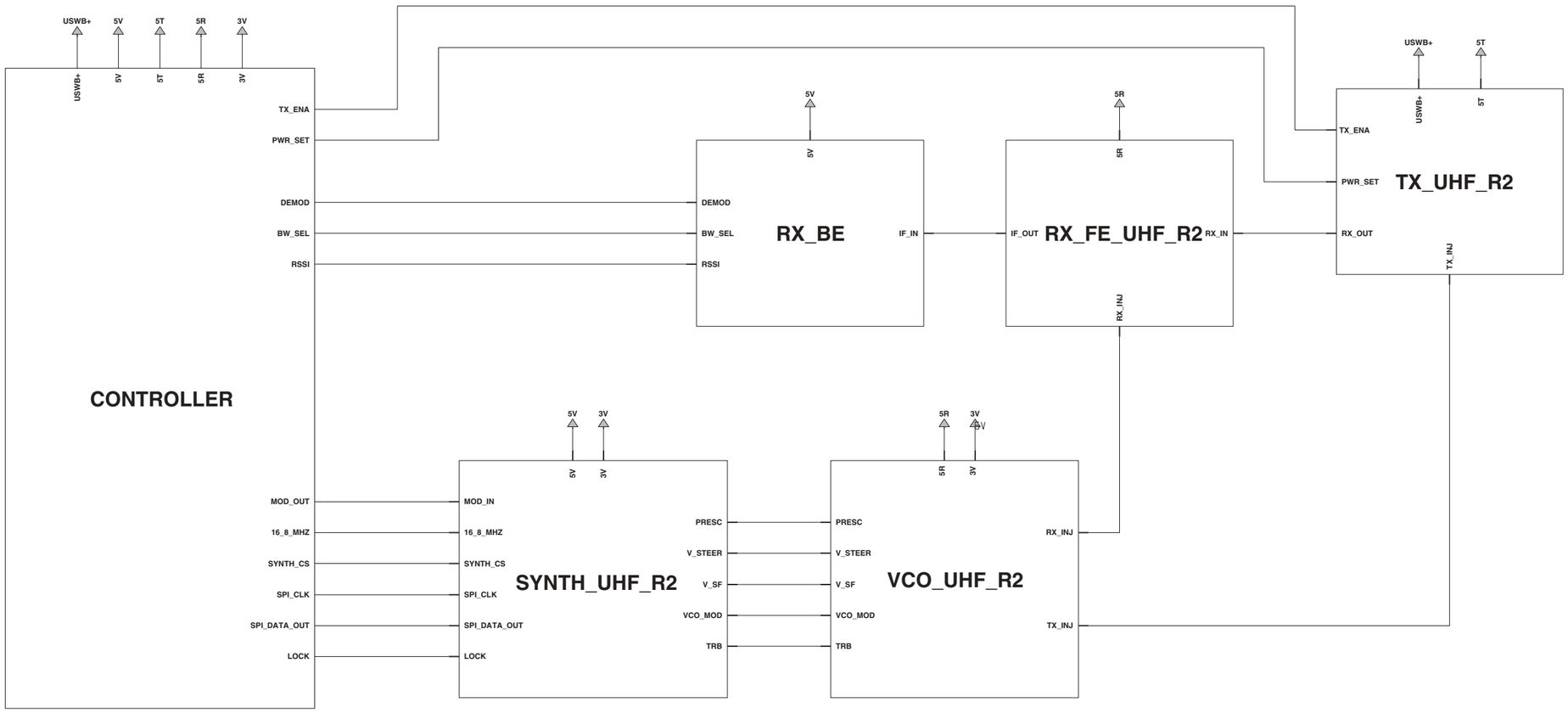


Figure 12-27. UHF (438-470 MHz) Radio Circuit Block Diagram (8486348Z13-C)

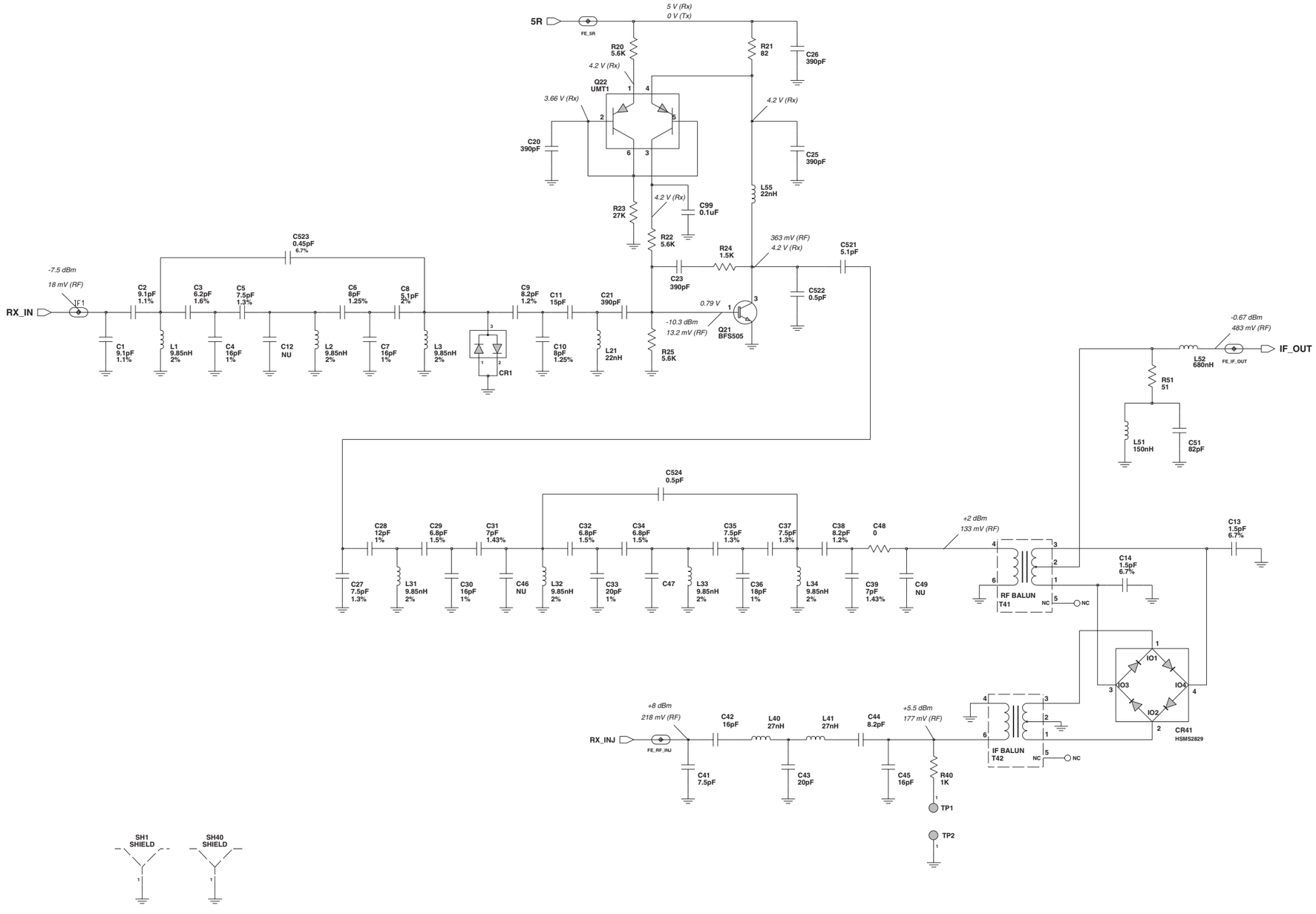


Figure 12-28. UHF (438-470 MHz) Receiver Front End Schematic Diagram (8486348Z13-C)

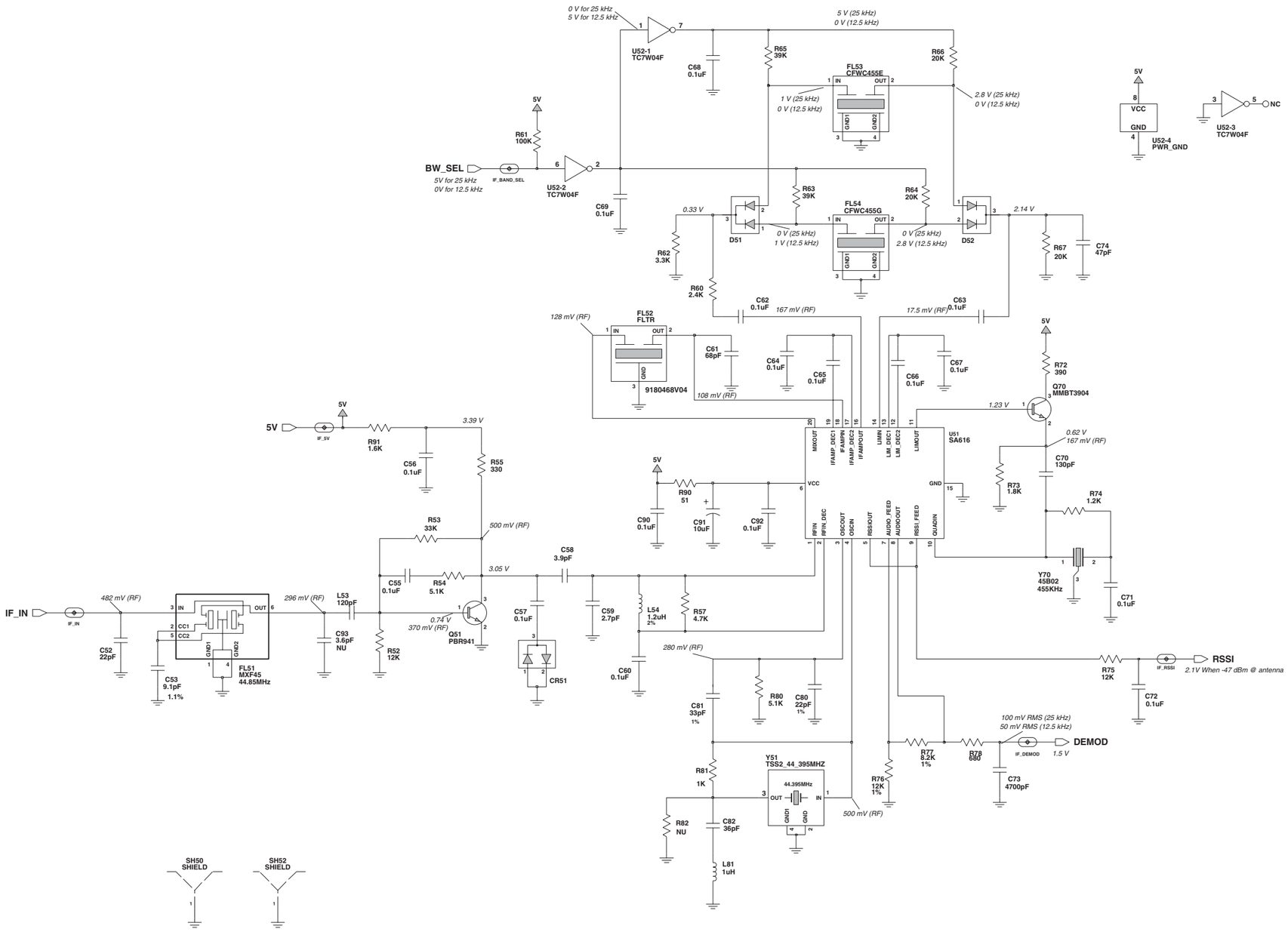
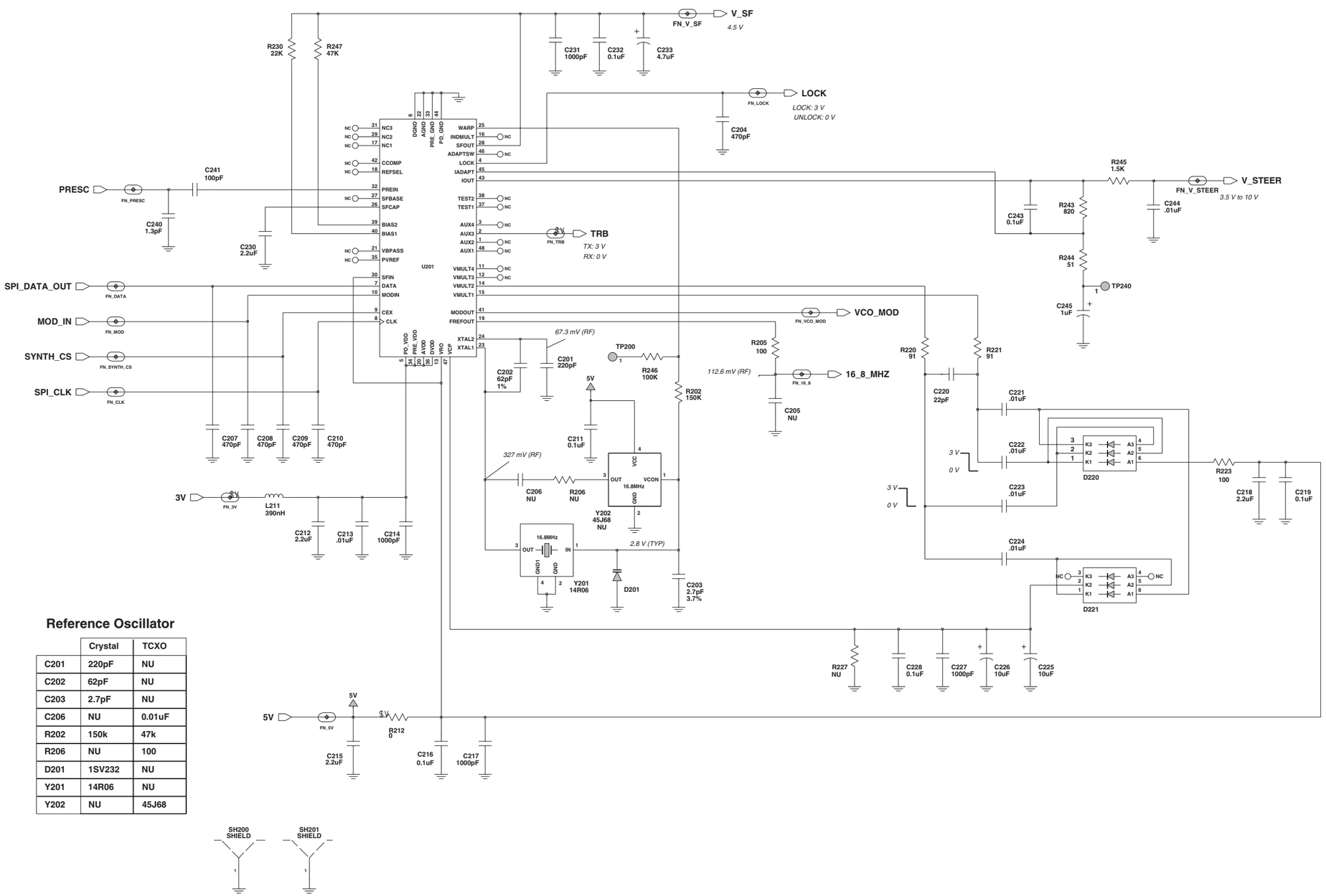


Figure 12-29. UHF (438-470 MHz) Receiver Back End Schematic Diagram (8486348Z13-C)



Reference Oscillator

	Crystal	TCXO
C201	220pF	NU
C202	62pF	NU
C203	2.7pF	NU
C206	NU	0.01uF
R202	150k	47k
R206	NU	100
D201	1SV232	NU
Y201	14R06	NU
Y202	NU	45J68

Figure 12-30. UHF (438-470 MHz) Synthesizer Schematic Diagram (8486348Z13-C)

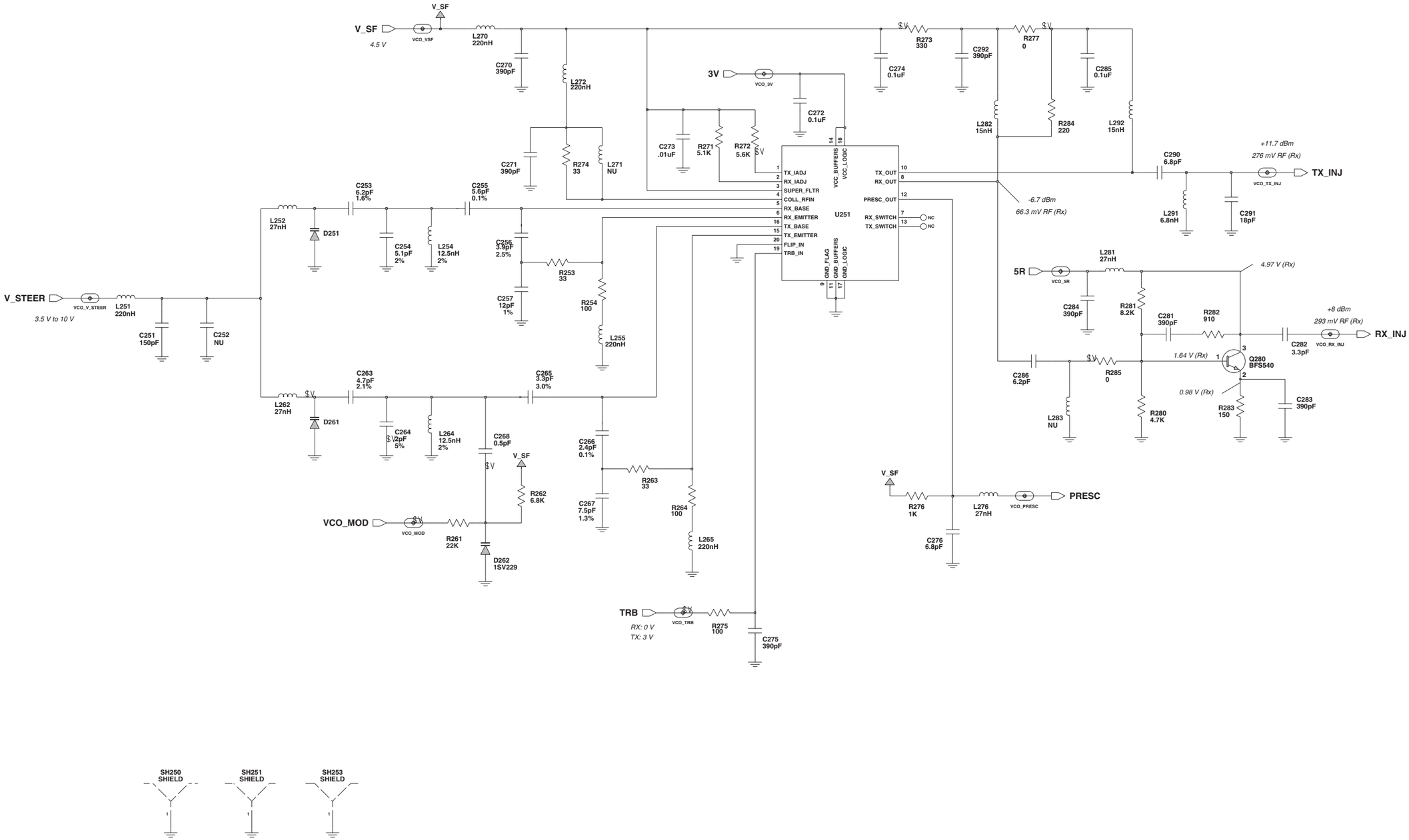


Figure 12-31. UHF (438-470 MHz) Voltage Controlled Oscillator Schematic Diagram (8486348Z13-C)

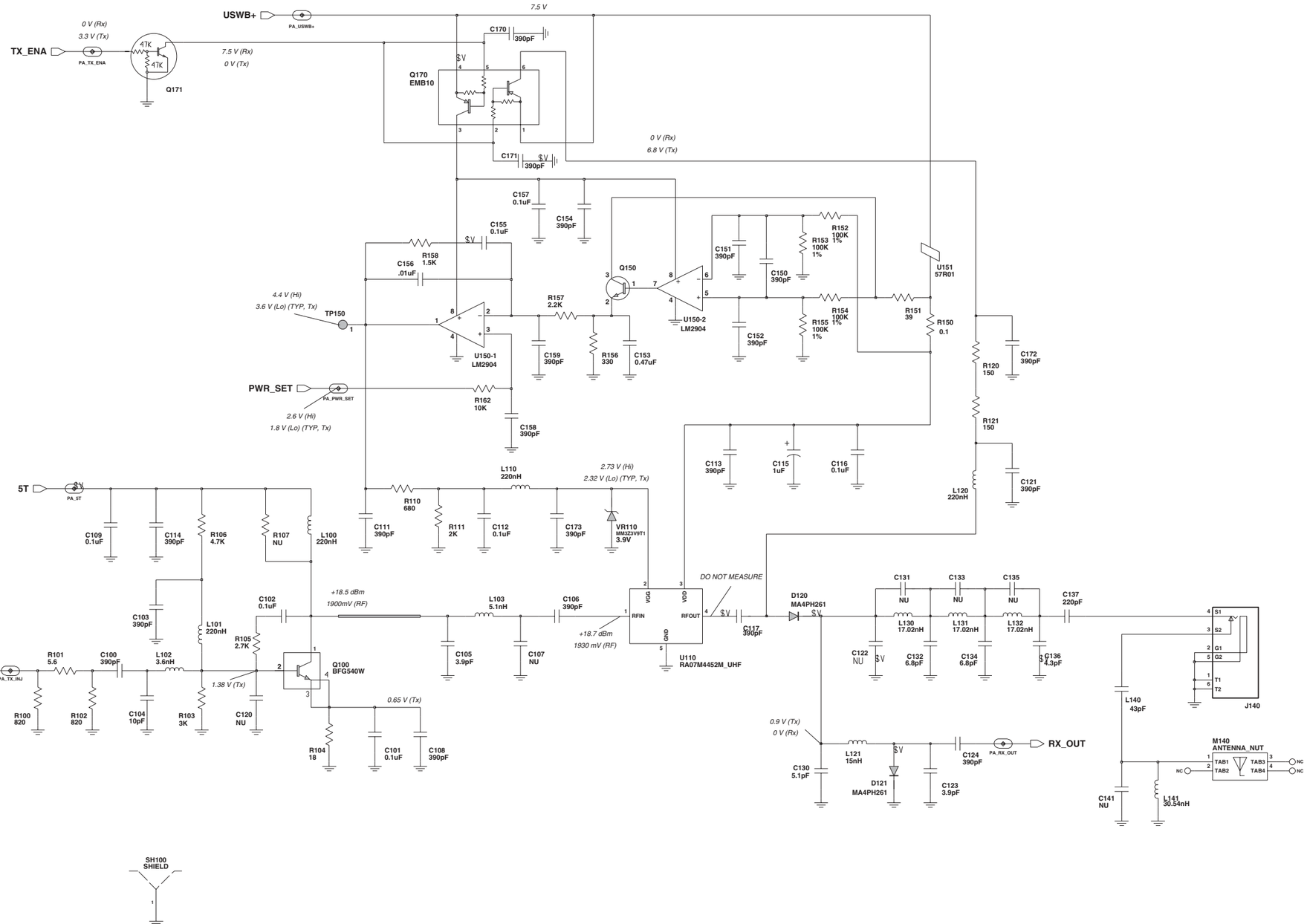


Figure 12-32. UHF (438-470 MHz) Transmitter and Power Control Schematic Diagram (8486348Z13-C)

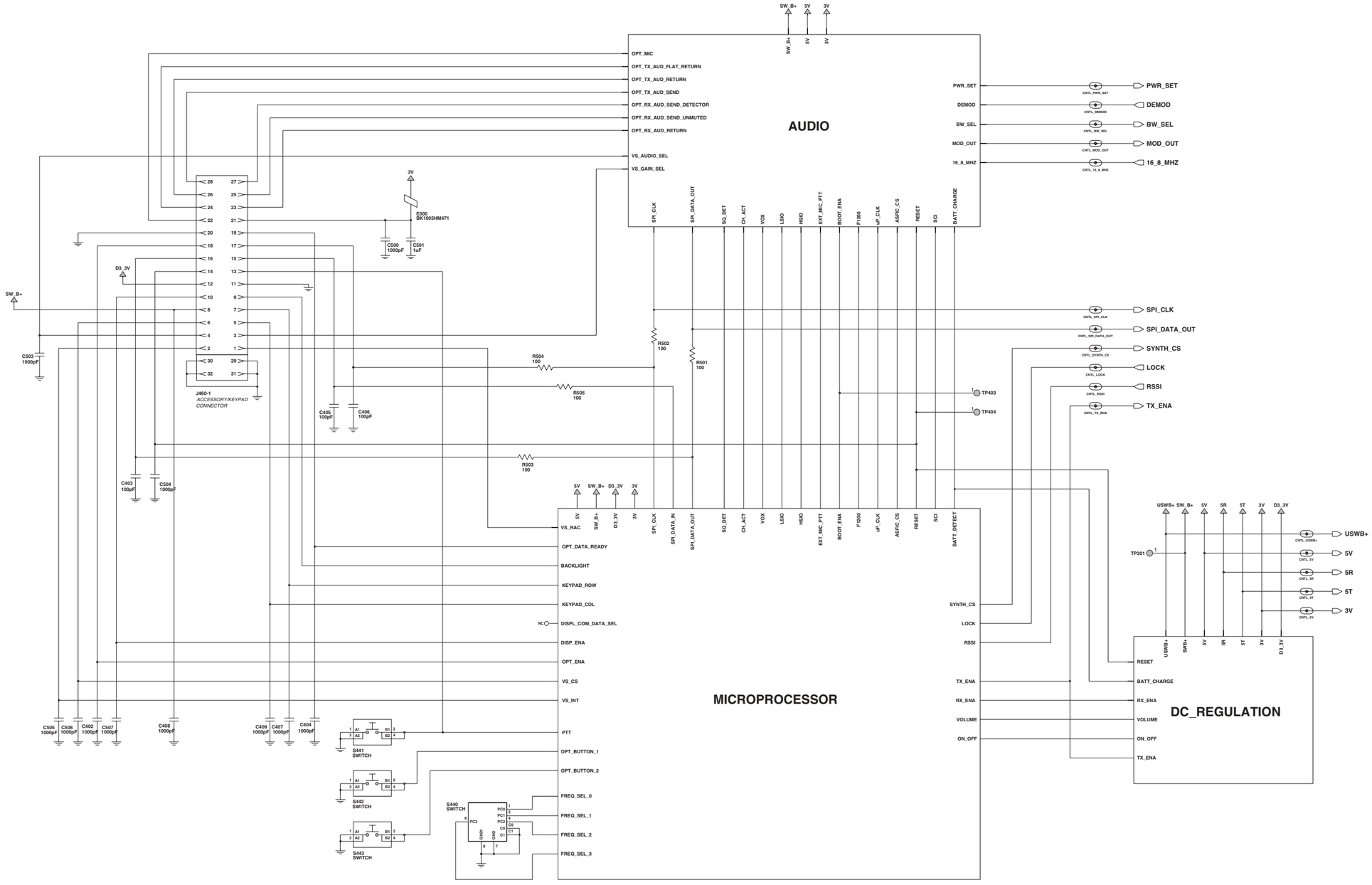


Figure 12-33. UHF (438-470 MHz) Controller Interconnect Schematic Diagram (8486348Z13-C)

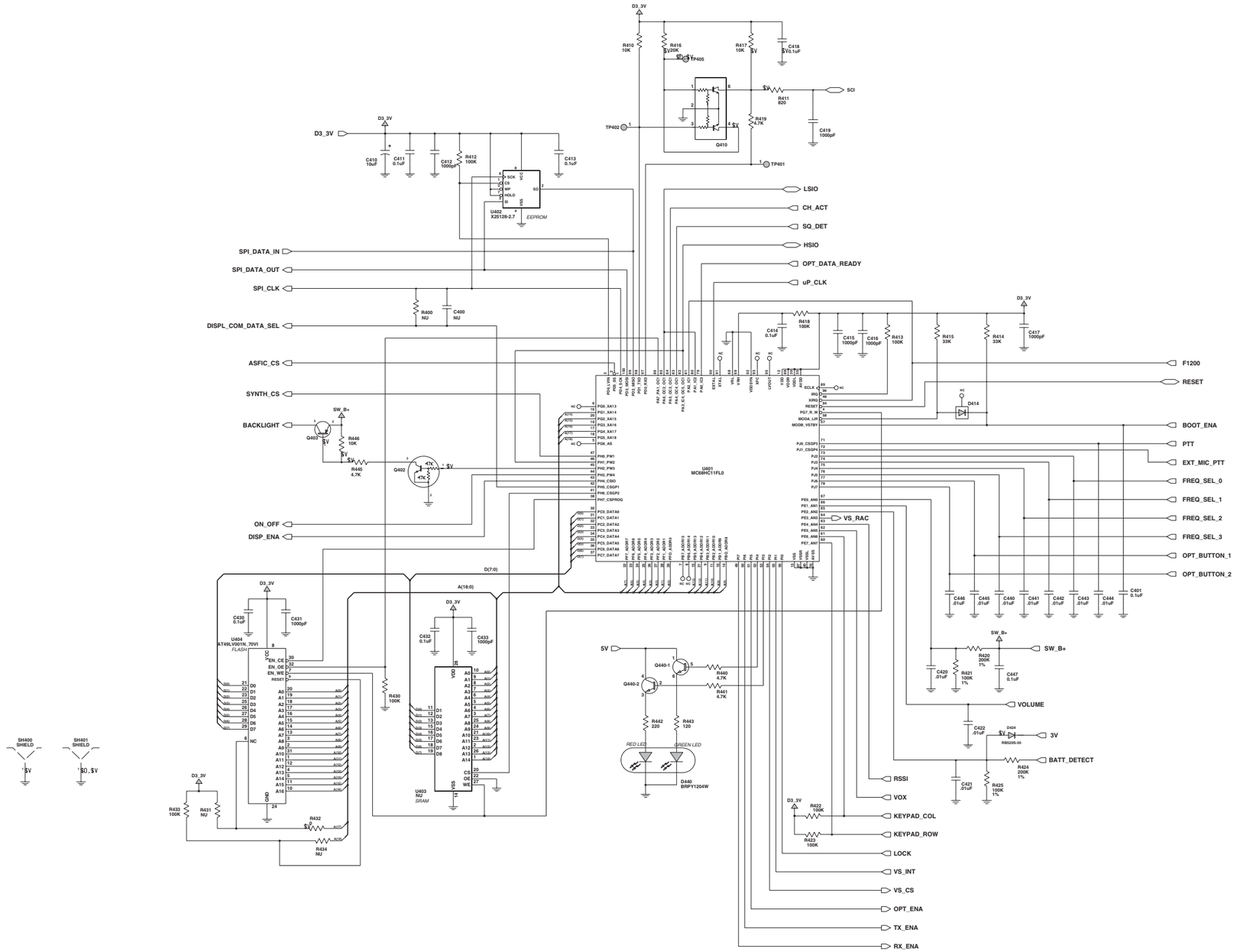


Figure 12-34. UHF (438-470 MHz) Microprocessor Circuitry Schematic Diagram (8486348Z13-C)

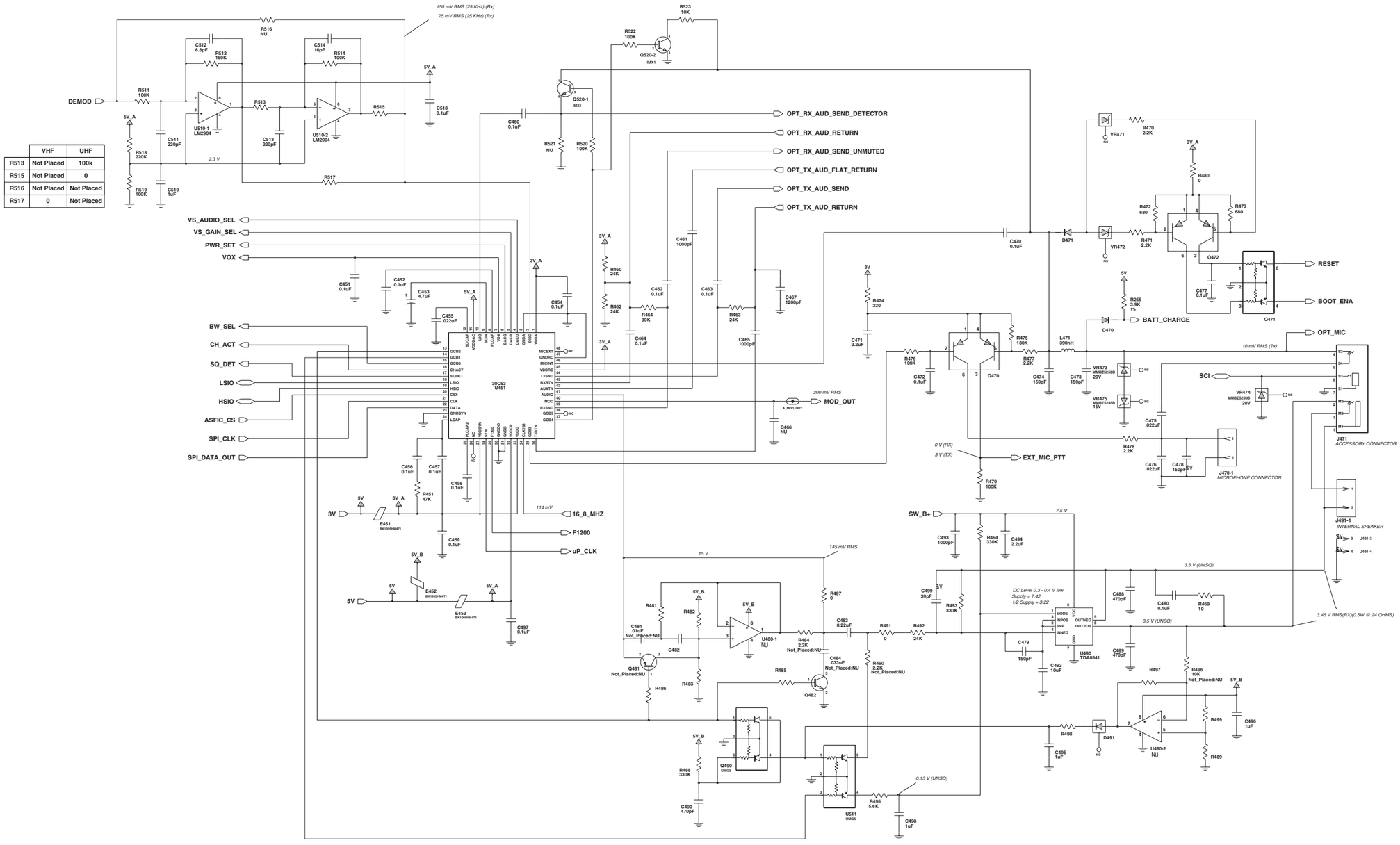


Figure 12-35. UHF (438-470 MHz) Audio Circuitry Schematic Diagram (8486348Z13-C)

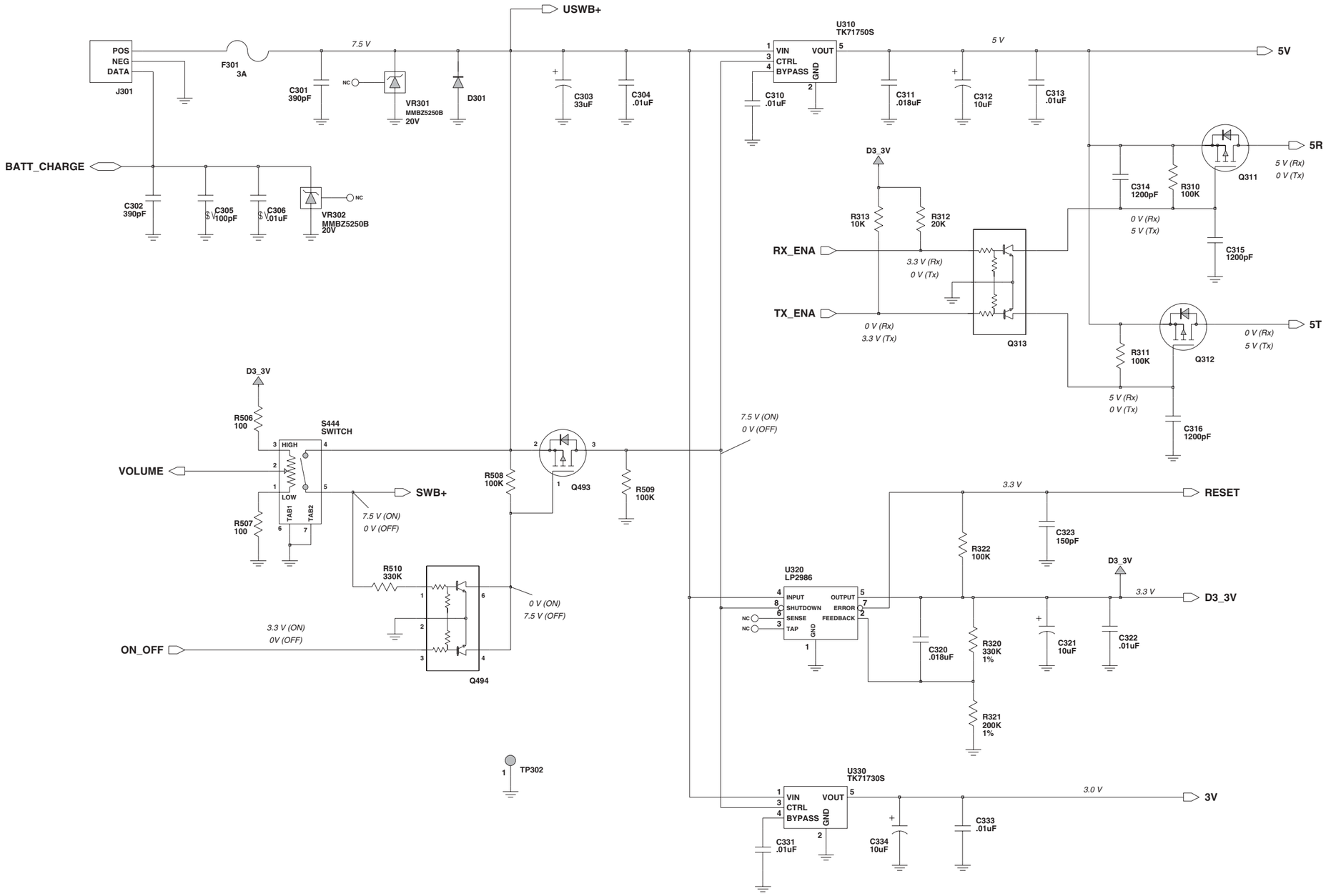


Figure 12-36. UHF (438-470 MHz) DC Regulation Schematic Diagram (8486348Z13-C)

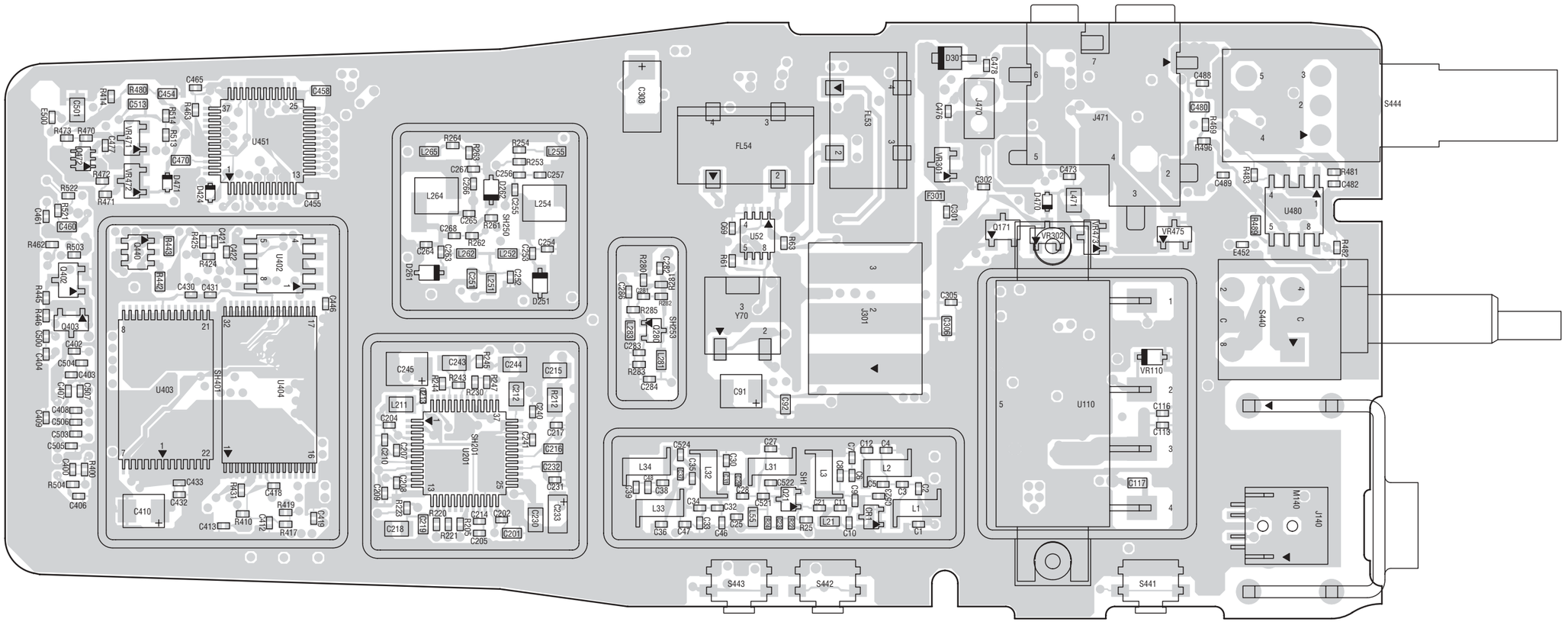


Figure 12-37. UHF (438-470 MHz) Board Component Side View (8486348Z13-C)

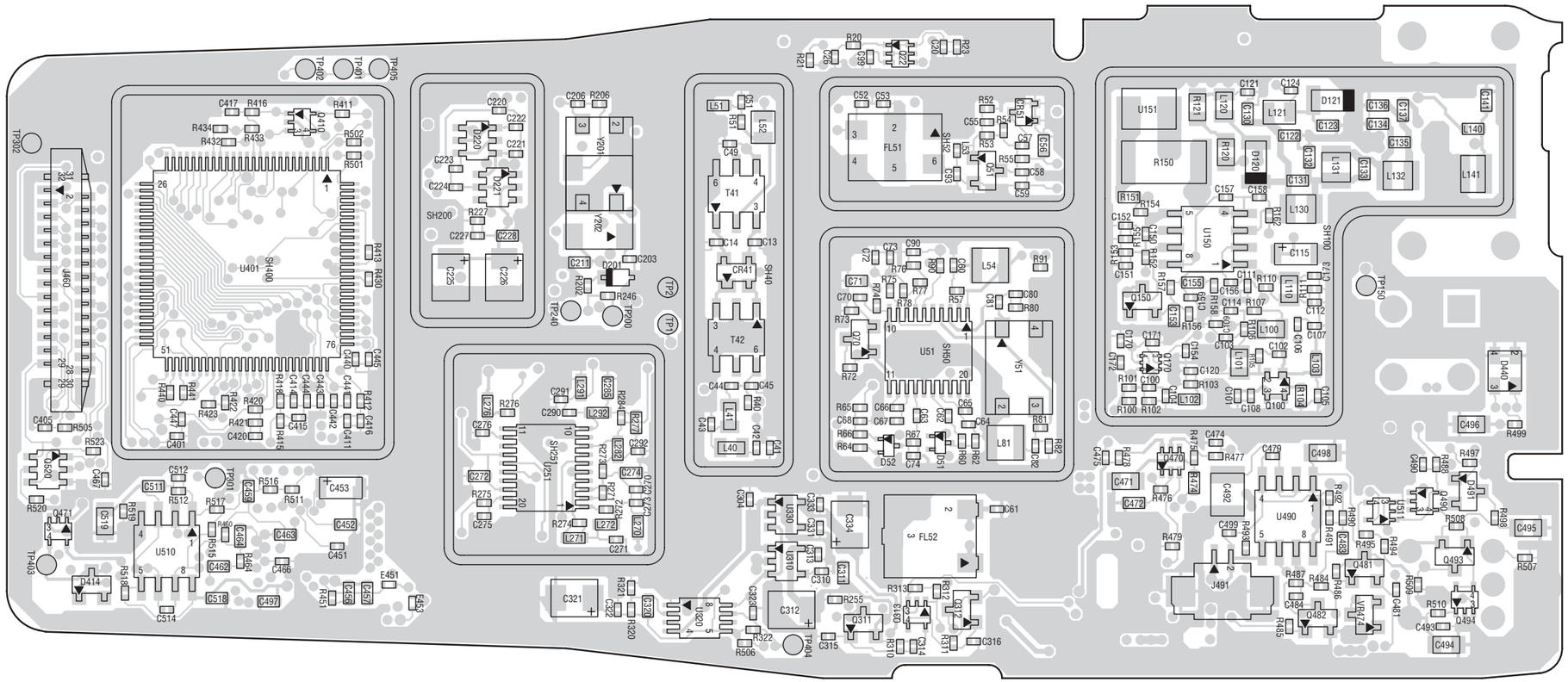


Figure 12-38. UHF (438-470 MHz) Board Solder Side View (8486348Z13-C)

UHF (438-470 MHz) Radio Parts List (8486348Z13-C)

Circuit Ref	Motorola Part No.	Description
C1	2109445U26	CAP, 9.1pF
C2	2109445U26	CAP, 9.1pF
C3	2109445U22	CAP, 6.2pF
C4	2109445U38	CAP, 16pF
C5	2109445U24	CAP, 7.5pF
C6	2109445U32	CAP, 8pF
C7	2109445U38	CAP, 16pF
C8	2109445U20	CAP, 5.1pF
C9	2109445U25	CAP, 8.2pF
C10	2109445U32	CAP, 8pF
C11	2113743N30	CAP, 15pF
C12	Not_Placed	CAP, 8.2pF
C13	2109445U07	CAP, 1.5pF
C14	2109445U07	CAP, 1.5pF
C20	2113743L07	CAP, 390pF
C21	2113743L07	CAP, 390pF
C23	2113743L07	CAP, 390pF
C25	2113743L07	CAP, 390pF
C26	2113743L07	CAP, 390pF
C27	2109445U24	CAP, 7.5pF
C28	2109445U35	CAP, 12pF
C29	2109445U23	CAP, 6.8pF
C30	2109445U38	CAP, 16pF
C31	2109445U31	CAP, 7pF
C32	2109445U23	CAP, 6.8pF
C33	2109445U40	CAP, 20pF
C34	2109445U23	CAP, 6.8pF
C35	2109445U24	CAP, 7.5pF
C36	2109445U39	CAP, 18pF
C37	2109445U24	CAP, 7.5pF
C38	2109445U25	CAP, 8.2pF
C39	2109445U31	CAP, 7pF
C41	2113743N23	CAP, 7.5pF
C42	2113743N31	CAP, 16pF
C43	2113743N33	CAP, 20pF
C44	2113743N24	CAP, 8.2pF
C45	2113743N31	CAP, 16pF
C46	Not_Placed	CAP, 10pF
C47	Not_Placed	CAP, 10pF
C48	0662057M01	RES, 0
C49	Not_Placed	CAP, 3.9pF
C51	2113743N48	CAP, 82pF
C52	2109445U41	CAP, 22pF
C53	2109445U26	CAP, 9.1pF
C55	2113743M24	CAP, 0.1uF
C56	2113743E20	CAP, 0.1uF
C57	2113743M24	CAP, 0.1uF
C58	2113743N16	CAP, 3.9pF
C59	2113743N12	CAP, 2.7pF
C60	2113743M24	CAP, 0.1uF
C61	2113743N46	CAP, 68pF
C62	2113743M24	CAP, 0.1uF
C63	2113743M24	CAP, 0.1uF
C64	2113743M24	CAP, 0.1uF
C65	2113743M24	CAP, 0.1uF
C66	2113743M24	CAP, 0.1uF
C67	2113743M24	CAP, 0.1uF
C68	2113743M24	CAP, 0.1uF
C69	2113743M24	CAP, 0.1uF
C70	2113743N53	CAP, 130pF
C71	2113743E20	CAP, 0.1uF
C72	2113743M24	CAP, 0.1uF
C73	2113743L33	CAP, 4700pF
C74	2113743N42	CAP, 47pF
C80	2109445U41	CAP, 22pF
C81	2109445U45	CAP, 33pF
C82	2109445U46	CAP, 36pF
C90	2113743M24	CAP, 0.1uF
C91	2311049A57	CAPP, 10uF
C92	2113743E20	CAP, 0.1uF
C93	Not_Placed	CAP, 3.6pF
C99	2113743M24	CAP, 0.1uF
C100	2113743L07	CAP, 390pF
C101	2113743M24	CAP, 0.1uF
C102	2113743M24	CAP, 0.1uF
C103	2113743L07	CAP, 390pF
C104	2113743N26	CAP, 10pF
C105	2113743N16	CAP, 3.9pF
C106	2113743L07	CAP, 390pF
C107	Not_Placed	CAP, 27pF
C108	2113743L07	CAP, 390pF
C109	2113743M24	CAP, 0.1uF
C111	2113743L07	CAP, 390pF
C112	2113743M24	CAP, 0.1uF
C113	2113743L07	CAP, 390pF
C114	2113743L07	CAP, 390pF
C115	2311049A07	CAPP, 1uF
C116	2113743M24	CAP, 0.1uF
C117	2113740F65	CAP, 390pF
C120	Not_Placed	CAP, 8.2pF
C121	2113743L07	CAP, 390pF
C122	Not_Placed	CAP, 5.1pF
C123	2113740F17	CAP, 3.9pF
C124	2113743L07	CAP, 390pF
C130	2113740F20	CAP, 5.1pF
C131	Not_Placed	CAP, 2.2pF
C132	2113740F23	CAP, 6.8pF
C133	Not_Placed	CAP, 2.7pF
C134	2113740F23	CAP, 6.8pF
C135	Not_Placed	CAP, 0.5pF
C136	2113740F18	CAP, 4.3pF
C137	2113740F59	CAP, 220pF
C141	Not_Placed	CAP, 8.2pF
C150	2113743L07	CAP, 390pF
C151	2113743L07	CAP, 390pF
C152	2113743L07	CAP, 390pF
C153	2113743K18	CAP, 0.47uF
C154	2113743L07	CAP, 390pF
C155	2113743E20	CAP, 0.1uF
C156	2113743L41	CAP, .01uF
C157	2113743M24	CAP, 0.1uF
C158	2113743L07	CAP, 390pF
C159	2113743L07	CAP, 390pF
C170	2113743L07	CAP, 390pF
C171	2113743L07	CAP, 390pF
C172	2113743L07	CAP, 390pF
C173	2113743L07	CAP, 390pF
C201	2113740F59	CAP, 220pF
C202	2109445U52	CAP, 62pF
C203	2109445U13	CAP, 2.7pF
C204	2113743L09	CAP, 470pF
C205	Not_Placed	CAP, 2.7pF
C206	Not_Placed	CAP, 1000pF
C207	2113743L09	CAP, 470pF
C208	2113743L09	CAP, 470pF
C209	2113743L09	CAP, 470pF
C210	2113743L09	CAP, 470pF
C211	2113743E20	CAP, 0.1uF
C212	2113743F18	CAP, 2.2uF
C213	2113743L41	CAP, .01uF
C214	2113743L17	CAP, 1000pF
C215	2113743F18	CAP, 2.2uF
C216	2113743E20	CAP, 0.1uF
C217	2113743L17	CAP, 1000pF
C218	2113743F18	CAP, 2.2uF
C219	2113743E20	CAP, 0.1uF
C220	2113743N34	CAP, 22pF
C221	2113743L41	CAP, .01uF
C222	2113743L41	CAP, .01uF
C223	2113743L41	CAP, .01uF
C224	2113743L41	CAP, .01uF
C225	2311049A57	CAPP, 10uF
C226	2311049A57	CAPP, 10uF
C227	2113743L17	CAP, 1000pF
C228	2113743E20	CAP, 0.1uF
C230	2113743F18	CAP, 2.2uF
C231	2113743L17	CAP, 1000pF
C232	2113743E20	CAP, 0.1uF
C233	2311049A56	CAPP, 4.7uF
C240	2113743N06	CAP, 1.3pF
C241	2113743N50	CAP, 100pF
C243	0886641Z01	CAP, 0.1uF
C244	0888600M25	CAP, .01uF
C245	2311049A08	CAPP, 1uF
C251	0888600M03	CAP, 150pF
C252	Not_Placed	CAP, 390pF
C253	2109445U22	CAP, 6.2pF
C254	2109445U20	CAP, 5.1pF
C255	2109445U21	CAP, 5.6pF
C256	2109445U17	CAP, 3.9pF
C257	2109445U35	CAP, 12pF
C263	2109445U19	CAP, 4.7pF
C264	2109445U10	CAP, 2pF
C265	2109445U15	CAP, 3.3pF
C266	2109445U12	CAP, 2.4pF
C267	2109445U24	CAP, 7.5pF
C268	2109445U01	CAP, 0.5pF
C270	2113743L07	CAP, 390pF
C271	2113743L07	CAP, 390pF
C272	2113743E20	CAP, 0.1uF
C273	2113743L41	CAP, .01uF
C274	2113743E20	CAP, 0.1uF
C275	2113743L07	CAP, 390pF
C276	2113743N22	CAP, 6.8pF
C281	2113743L07	CAP, 390pF
C282	2113743N14	CAP, 3.3pF
C283	2113743L07	CAP, 390pF
C284	2113743L07	CAP, 390pF
C285	2113743E20	CAP, 0.1uF
C286	2113743N21	CAP, 6.2pF
C290	2113743N22	CAP, 6.8pF
C291	2113743N32	CAP, 18pF
C292	2113743L07	CAP, 390pF
C301	2113743L07	CAP, 390pF
C302	2113743L07	CAP, 390pF
C303	2311049A97	CAPP, 33uF
C304	2113743L41	CAP, .01uF
C305	2113743N50	CAP, 100pF
C306	2113741F49	CAP, .01uF
C310	2113743L41	CAP, .01uF
C311	2113743E05	CAP, .018uF
C312	2311049A57	CAPP, 10uF
C313	2113743L41	CAP, .01uF
C314	2113743L19	CAP, 1200pF
C315	2113743L19	CAP, 1200pF
C316	2113743L19	CAP, 1200pF
C320	2113743E05	CAP, .018uF
C321	2311049A57	CAPP, 10uF
C322	2113743L41	CAP, .01uF
C323	2113743N54	CAP, 150pF
C331	2113743L41	CAP, .01uF
C333	2113743L41	CAP, .01uF
C334	2311049A57	CAPP, 10uF

Circuit Ref	Motorola Part No.	Description
C400	Not_Placed	CAP, .022uF
C401	2113743M24	CAP, 0.1uF
C402	2113743L17	CAP, 1000pF
C403	2113743N50	CAP, 100pF
C404	2113743L17	CAP, 1000pF
C405	2113743N50	CAP, 100pF
C406	2113743N50	CAP, 100pF
C407	2113743L17	CAP, 1000pF
C408	2113743L17	CAP, 1000pF
C409	2113743L17	CAP, 1000pF
C410	2311049A57	CAPP, 10uF
C411	2113743M24	CAP, 0.1uF
C412	2113743L17	CAP, 1000pF
C413	2113743M24	CAP, 0.1uF
C414	2113743M24	CAP, 0.1uF
C415	2113743L17	CAP, 1000pF
C416	2113743L17	CAP, 1000pF
C417	2113743L17	CAP, 1000pF
C418	2113743M24	CAP, 0.1uF
C419	2113743L17	CAP, 1000pF
C420	2113743L41	CAP, .01uF
C421	2113743L41	CAP, .01uF
C422	2113743L41	CAP, .01uF
C430	2113743M24	CAP, 0.1uF
C431	2113743L17	CAP, 1000pF
C432	2113743M24	CAP, 0.1uF
C433	2113743L17	CAP, 1000pF
C440	2113743L41	CAP, .01uF
C441	2113743L41	CAP, .01uF
C442	2113743L41	CAP, .01uF
C443	2113743L41	CAP, .01uF
C444	2113743L41	CAP, .01uF
C445	2113743L41	CAP, .01uF
C446	2113743L41	CAP, .01uF
C447	2113743M24	CAP, 0.1uF
C451	2113743M24	CAP, 0.1uF
C452	2113743E20	CAP, 0.1uF
C453	2311049A56	CAPP, 4.7uF
C454	2113743E20	CAP, 0.1uF
C455	2113743L48	CAP, .022uF
C456	2113743E20	CAP, 0.1uF
C457	2113743E20	CAP, 0.1uF
C458	2113743E20	CAP, 0.1uF
C459	2113743E20	CAP, 0.1uF
C460	2113743E20	CAP, 0.1uF
C461	2113743L17	CAP, 1000pF
C462	2113743E20	CAP, 0.1uF
C463	2113743E20	CAP, 0.1uF
C464	2113743E20	CAP, 0.1uF
C465	2113743L17	CAP, 1000pF
C466	Not_Placed	CAP, 470pF
C467	2113743L19	CAP, 1200pF
C470	2113743E20	CAP, 0.1uF
C471	2113743F18	CAP, 2.2uF
C472	2113743E20	CAP, 0.1uF
C473	2113743N54	CAP, 150pF
C474	2113743N54	CAP, 150pF
C475	2113743L48	CAP, .022uF
C476	2113743L48	CAP, .022uF
C477	2113743M24	CAP, 0.1uF
C478	2113743N54	CAP, 150pF
C479	2113743N54	CAP, 150pF
C480	2113743E20	CAP, 0.1uF
C481	Not_Placed	CAP, .01uF
C482	Not_Placed	CAP, .01uF
C483	2113928H02	CAP, 0.22uF
C484	Not_Placed	CAP, .033uF
C488	2113743L09	CAP, 470pF
C489	2113743L09	CAP, 470pF
C490	2113743L09	CAP, 470pF
C492	2113928J08	CAP, 10uF
C493	2113743L17	CAP, 1000pF
C494	2113743F18	CAP, 2.2uF
C495	2113743F16	CAP, 1uF
C496	2113743F16	CAP, 1uF
C497	2113743E20	CAP, 0.1uF
C498	2113743F16	CAP, 1uF
C499	2113743N40	CAP, 39pF
C500	2113743L17	CAP, 1000pF
C501	2113743F16	CAP, 1uF
C503	2113743L17	CAP, 1000pF
C504	2113743L17	CAP, 1000pF
C505	2113743L17	CAP, 1000pF
C506	2113743L17	CAP, 1000pF
C507	2113743L17	CAP, 1000pF
C511	2113740F59	CAP, 220pF
C512	2113743N22	CAP, 6.8pF
C513	2113740F59	CAP, 220pF
C514	2113743N31	CAP, 16pF
C518	2113743E20	CAP, 0.1uF
C519	2113743F16	CAP, 1uF
C521	2109445U20	CAP, 5.1pF
C522	2109445U01	CAP, 0.5pF
C523	2186463Z02	CAP, 0.45pF
C524	2186463Z03	CAP, 0.5pF
CR1	4813825A19	dual Schottky, MMBD352
CR41	4802246J04	quad ring diode, HSMS2829
CR51	4813825A19	dual Schottky, MMBD352
D51	4802245J97	dual silicon, DAN235ETL
D52	4802245J97	dual silicon, DAN235ETL
D120	4880973Z02	silicon, PIN, MA4PH261
D121	4880973Z02	silicon PIN, MA4PH261
D201	4862824C03	varactor, 1SV232
D220	4802233J09	triple diode, IMN10
D221	4802233J09	triple diode, IMN10
D251	4862824C01	varactor, 1SV229
D261	4862824C01	varactor, 1SV229
D262	4862824C01	varactor, 1SV229
D301	4813833A19	silicon, reverse polarity, MBRM120ET3
D414	4805129M41	Schottky, MMBD501
D424	4809924D18	Schottky, RB520S-30
D440	4805729G49	dual LED red/green, BRPY1204W
D470	4809924D18	Schottky, RB520S-30
D471	4809924D18	Schottky, RB520S-30
D491	Not_Placed	MMBD501
E451	2480640Z01	bead, BK1005HM471
E452	2480640Z01	bead, BK1005HM471
E453	2480640Z01	bead, BK1005HM471
E500	2480640Z01	bead, BK1005HM471
F301	6580542Z01	fuse, 3 amp
FL51	9180022M11	4-pole cyrstal filter, 44.85 MHz, MXF45
FL52	9180468V04	4-pole ceramic filter, 455 kHz, CFU455F
FL53	9180469V05	6-pole ceramic filter, 455 kHz, CFWC455E
FL54	9180469V03	6-pole ceramic filter, 455 KHz, CFWC455G
J140	0986428Z01	connector, external antenna
J301	0986565Z01	battery contact assembly
J460	Not_Placed	CONN_J
J470	0985818A01	connector, 2-pin, internal mic
J471	0980683Z03	connector, 2.5 / 3.5 mm, accessories
J491	2809926G01	connector, 2-pin, internal speaker
L1	2409348J15	IDCTR, 9.85nH
L2	2409348J15	IDCTR, 9.85nH
L3	2409348J15	IDCTR, 9.85nH
L21	2413926N16	IDCTR, 22nH
L31	2409348J15	IDCTR, 9.85nH
L32	2409348J15	IDCTR, 9.85nH
L33	2409348J15	IDCTR, 9.85nH
L34	2409348J15	IDCTR, 9.85nH
L40	2413926K16	IDCTR, 27nH
L41	2413926K16	IDCTR, 27nH
L51	2413926N26	IDCTR, 150nH
L52	2462587V44	IDCTR, 680nH
L53	2113743N52	CAP, 120pF
L54	2413923A25	IDCTR, 1.2uH
L55	2413926N16	IDCTR, 22nH
L81	2413923A19	IDCTR, 1uH
L100	2413926K27	IDCTR, 220nH
L101	2413926K27	IDCTR, 220nH
L102	2409377M21	IDCTR, 3.6nH
L103	2409377M24	IDCTR, 5.1nH
L110	2413926K27	IDCTR, 220nH
L120	2413926K27	IDCTR, 220nH
L121	2462587V24	IDCTR, 15nH
L130	2460591C40	IDCTR, 17.02nH
L131	2460591C40	IDCTR, 17.02nH
L132	2460591C40	IDCTR, 17.02nH
L140	2113740F42	CAP, 43pF
L141	2479990M01	IDCTR, 30.54nH
L211	2413926K30	IDCTR, 390nH
L251	2413926N28	IDCTR, 220nH
L252	2413926N17	IDCTR, 27nH
L254	2484562T11	IDCTR, 12.5nH
L255	2413926N28	IDCTR, 220nH
L262	2413926N17	IDCTR, 27nH
L264	2484562T11	IDCTR, 12.5nH
L265	2413926N28	IDCTR, 220nH
L270	2413926N28	IDCTR, 220nH
L271	Not_Placed	IDCTR, 220nH
L272	2413926N28	IDCTR, 220nH
L276	2413926N17	IDCTR, 27nH
L281	2413926N17	IDCTR, 27nH
L282	2413926N14	IDCTR, 15nH
L283	Not_Placed	IDCTR, 22nH
L291	2413926N10	IDCTR, 6.8nH
L292	2413926N14	IDCTR, 15nH
L471	2413926K30	IDCTR, 390nH
M140	0286427Z01	antenna nut
Q21	4802247J01	silicon NPN, BFS505
Q22	4805723X02	dual silicon PNP, UMT1
Q51	4802197J95	silicon NPN, PBR941
Q70	4880214G02	silicon NPN, MMBT3904
Q100	4885593U03	silicon NPN, BFG540W
Q150	4880214G02	silicon NPN, MMBT3904
Q170	4809939C34	dual silicon PNP, EMB10
Q171	4880048M01	digital NPN, DTC144EKA
Q280	4802245J95	silicon, NPN, BFS540
Q311	4809579E18	P-channel MOSFET, TP0101T
Q312	4809579E18	P-channel MOSFET, TP0101T
Q313	4802245J54	dual digital NPN, UMG5
Q402	4880048M01	digital NPN, DTC144EKA
Q403	4813824A17	silicon PNP, MMBT3906
Q410	4802245J54	dual digiial NPN, UMG5
Q440	5180159R01	dual NPN, IMX1
Q470	4805723X02	dual silicon PNP, UMT1
Q471	4802245J54	dual digital NPN, UMG5
Q472	4805723X02	dual silicon PNP, UMT1

Circuit Ref	Motorola Part No.	Description
Q481	Not_Placed	MMBT3906
Q482	Not_Placed	MMBT3904
Q490	4802245J54	dual digital NPN, UMG5
Q493	4809579E18	P-channel MOSFET, TP0101T
Q494	4802245J54	dual digital NPN, UMG5
Q520	5180159R01	dual NPN, IMX1
R20	0662057M92	RES, 5.6K
R21	0662057M48	RES, 82
R22	0662057M92	RES, 5.6K
R23	0662057N09	RES, 27K
R24	0662057M78	RES, 1.5K
R25	0662057M92	RES, 5.6K
R40	0662057M74	RES, 1K
R51	0662057M43	RES, 51
R52	0662057N01	RES, 12K
R53	0662057N11	RES, 33K
R54	0662057M91	RES, 5.1K
R55	0662057M62	RES, 330
R57	0662057M90	RES, 4.7K
R60	0662057M83	RES, 2.4K
R61	0662057N23	RES, 100K
R62	0662057M86	RES, 3.3K
R63	0662057N13	RES, 39K
R64	0662057N06	RES, 20K
R65	0662057N13	RES, 39K
R66	0662057N06	RES, 20K
R67	0662057N06	RES, 20K
R72	0662057M64	RES, 390
R73	0662057M80	RES, 1.8K
R74	0662057M76	RES, 1.2K
R75	0662057N01	RES, 12K
R76	0662057V04	RES, 12K
R77	0662057U99	RES, 8.2K
R78	0662057M70	RES, 680
R80	0662057M91	RES, 5.1K
R81	0662057M74	RES, 1K
R82	Not_Placed	RES, 0
R90	0662057M43	RES, 51
R91	0662057M79	RES, 1.6K
R100	0662057M72	RES, 820
R101	0662057M20	RES, 5.6
R102	0662057M72	RES, 820
R103	0662057M85	RES, 3K
R104	0662057A07	RES, 18
R105	0662057M84	RES, 2.7K
R106	0662057M90	RES, 4.7K
R107	Not_Placed	RES, 300
R110	0662057M70	RES, 680
R111	0662057M81	RES, 2K
R120	0662057C55	RES, 150
R121	0662057C55	RES, 150
R150	0680539Z01	RES, 0.1
R151	0662057A15	RES, 39
R152	0662057V27	RES, 100K
R153	0662057V27	RES, 100K
R154	0662057V27	RES, 100K
R155	0662057V27	RES, 100K
R156	0662057M62	RES, 330
R157	0662057M82	RES, 2.2K
R158	0662057M78	RES, 1.5K
R162	0662057M98	RES, 10K
R202	0662057N27	RES, 150K
R205	0662057M50	RES, 100
R206	Not_Placed	RES, 100
R212	0662057C01	RES, 0
R220	0662057M49	RES, 91
R221	0662057M49	RES, 91
R223	0662057M50	RES, 100
R227	Not_Placed	RES, 150K
R230	0662057N07	RES, 22K
R243	0662057M72	RES, 820
R244	0662057M43	RES, 51
R245	0662057M78	RES, 1.5K
R246	0662057N23	RES, 100K
R247	0662057N15	RES, 47K
R253	0662057M38	RES, 33
R254	0662057M50	RES, 100
R255	0662057U91	RES, 3.9K
R261	0662057N07	RES, 22K
R262	0662057M94	RES, 6.8K
R263	0662057M38	RES, 33
R264	0662057M50	RES, 100
R271	0662057M91	RES, 5.1K
R272	0662057M92	RES, 5.6K
R273	0662057M62	RES, 330
R274	0662057M38	RES, 33
R275	0662057M50	RES, 100
R276	0662057M74	RES, 1K
R277	0662057B47	RES, 0
R280	0662057M90	RES, 4.7K
R281	0662057M96	RES, 8.2K
R282	0662057M73	RES, 910
R283	0662057M54	RES, 150
R284	0662057M58	RES, 220
R285	0662057M01	RES, 0
R310	0662057N23	RES, 100K
R311	0662057N23	RES, 100K
R312	0662057N06	RES, 20K
R313	0662057M98	RES, 10K
R320	0662057V43	RES, 330K
R321	0662057V35	RES, 200K
R322	0662057N23	RES, 100K
R400	Not_Placed	RES, 100K
R410	0662057M98	RES, 10K
R411	0662057M72	RES, 820
R412	0662057N23	RES, 100K
R413	0662057N23	RES, 100K
R414	0662057N11	RES, 33K
R415	0662057N11	RES, 33K
R416	0662057N06	RES, 20K
R417	0662057M98	RES, 10K
R418	0662057N23	RES, 100K
R419	0662057M90	RES, 4.7K
R420	0662057V35	RES, 200K
R421	0662057V27	RES, 100K
R422	0662057N23	RES, 100K
R423	0662057N23	RES, 100K
R424	0662057V35	RES, 200K
R425	0662057V27	RES, 100K
R430	0662057N23	RES, 100K
R431	Not_Placed	RES, 100K
R432	0662057M01	RES, 0
R433	0662057N23	RES, 100K
R434	Not_Placed	RES, 100K
R440	0662057M90	RES, 4.7K
R441	0662057M90	RES, 4.7K
R442	0662057A33	RES, 220
R443	0662057A27	RES, 120
R445	0662057M90	RES, 4.7K
R446	0662057M98	RES, 10K
R451	0662057N15	RES, 47K
R460	0662057N08	RES, 24K
R462	0662057N08	RES, 24K
R463	0662057N08	RES, 24K
R464	0662057N10	RES, 30K
R469	0662057M26	RES, 10
R470	0662057M82	RES, 2.2K
R471	0662057M82	RES, 2.2K
R472	0662057M70	RES, 680
R473	0662057M70	RES, 680
R474	0662057A37	RES, 330
R475	0662057N29	RES, 180K
R476	0662057N23	RES, 100K
R477	0662057M82	RES, 2.2K
R478	0662057M82	RES, 2.2K
R479	0662057N23	RES, 100K
R480	0662057B47	RES, 0
R481	Not_Placed	RES, 100K
R482	Not_Placed	RES, 330K
R483	Not_Placed	RES, 150K
R484	Not_Placed	RES, 2.2K
R485	Not_Placed	RES, 100K
R486	Not_Placed	RES, 100K
R487	0662057M01	RES, 0
R488	0662057N35	RES, 330K
R489	Not_Placed	RES, 91K
R490	Not_Placed	RES, 2.2K
R491	0662057M01	RES, 0
R492	0662057N08	RES, 24K
R493	0662057N35	RES, 330K
R494	0662057V43	RES, 330K
R495	0662057M92	RES, 5.6K
R496	Not_Placed	RES, 10K
R497	Not_Placed	RES, 1MEG
R498	Not_Placed	RES, 47K
R499	Not_Placed	RES, 270K
R501	0662057M50	RES, 100
R502	0662057M50	RES, 100
R503	0662057M50	RES, 100
R504	0662057M50	RES, 100
R505	0662057M50	RES, 100
R506	0662057M50	RES, 100
R507	0662057M50	RES, 100
R508	0662057N23	RES, 100K
R509	0662057N23	RES, 100K
R510	0662057N35	RES, 330K
R511	0662057N23	RES, 100K
R512	0662057N27	RES, 150K
R513	0662057N23	RES, 100K
R514	0662057N23	RES, 100K
R515	0662057M01	RES, 0
R516	Not_Placed	RES, 0
R517	Not_Placed	RES, 0
R518	0662057N31	RES, 220K
R519	0662057N23	RES, 100K
R520	0662057N23	RES, 100K
R521	Not_Placed	RES, 100K
R522	0662057N23	RES, 100K
R523	0662057M98	RES, 10K
S440	4080710Z22	switch, rotary 16-channel select
	or 4080710Z13	switch, rotary 4-channel select
S441	4070354A01	switch, pushbutton PTT
S442	4070354A01	switch, pushbutton, side option (lower)
S443	4070354A01	switch, pushbutton, side option (upper)
S444	1880619Z02	switch, rotary on-off, with 10K volume control
SH1	2686421Z01	shield, comp side, RF front end
SH40	2686419Z01	shield, solder side, first mixer

Circuit Ref	Motorola Part No.	Description
SH50	2686423Z01	shield, solder side, IFIC and 2nd LO cyrstal
SH52	2686424Z01	shield, solder side, high IF crystal filter
SH100	2686418Z01	shield, solder side, transmitter
SH200	2686424Z01	shield, solder side, synthe-sizer charge pump
SH201	2686423Z01	shield, comp side, synthesizer
SH250	2686425Z01	shield, comp side, VCO tank circuits
SH251	2686425Z01	shield, solder side, VCOBIC
SH253	2686422Z01	shield, comp side, VCO RX injection buffer
SH400	2686420Z01	shield, solder side, micropro-cessor
SH401	2686420Z01	shield, comp side, memory
T41	2580541Z02	transformer, balun
T42	2580541Z02	transformer, balun
U51	5186144B01	receiver system (IFIC), SA616
U52	5109522E10	triple inverter, TC7W04F
U110	0186438Z02	transmitter PA module, RA07M4452M_UHF
U150	5113818A01	dual op amp, LM2904
U151	2484657R01	bead, 57R01
U201*	5185963A27	freuqency synthesizer, 63A27
U251	5105750U54	VCO/buffer, 50U54
U310	5102478J01	5 V voltage reguator, TK71750S
U320	5185963A55	adjustable voltage regulator w/ reset, LP2986
U330	5102479J01	3 V voltage regulator, TK71730S
U401*	5102226J56	microprocessor, MC68HC11FL0
U402*	5102463J64	serial EEPROM 16Kx8, X25128-2.7
U403	Not_Placed	SRM2B256
U404*	5102480J01	Flash ROM 128Kx8, AT49LV001N_70VI
U451	5185130C53	audio filter (ASFIC_cmp), 30C53
U480	Not_Placed	LM2904
U490	5108858K99	audio power amplifier, TDA8541
U510	5113818A01	dual op amp, LM2904
U511	4802245J54	dual digital NPN, UMG5
VR110	4813830A86	zener diode, 3.9 V, MM3Z3V9T1
VR301	4813830A33	zener diode, 20 V, MMBZ5250B
VR302	4813830A33	zener diode, 20 V, MMBZ5250B
VR471	4813830A18	zener diode, 6.8 V, MMBZ5235B
VR472	4813830A09	zener diode, 3.3 V, MMBZ5226B
VR473	4813830A33	zener diode 20 V, MMBZ5250B
VR474	4813830A33	zener diode, 20 V, MMBZ5250B
VR475	4880140L20	zener diode, 15 V, MMBZ5245B
Y51	4802245J84	crystal, 44.395 MHz, TSS2_44_395MHZ
Y70	9186145B02	ceramic discriminator, 455 kHz, 45B02
Y201*	4880114R06	crystal, 16.8 MHz, 14R06
Y202	Not_Placed	45J68

* Motorola Depot Servicing only

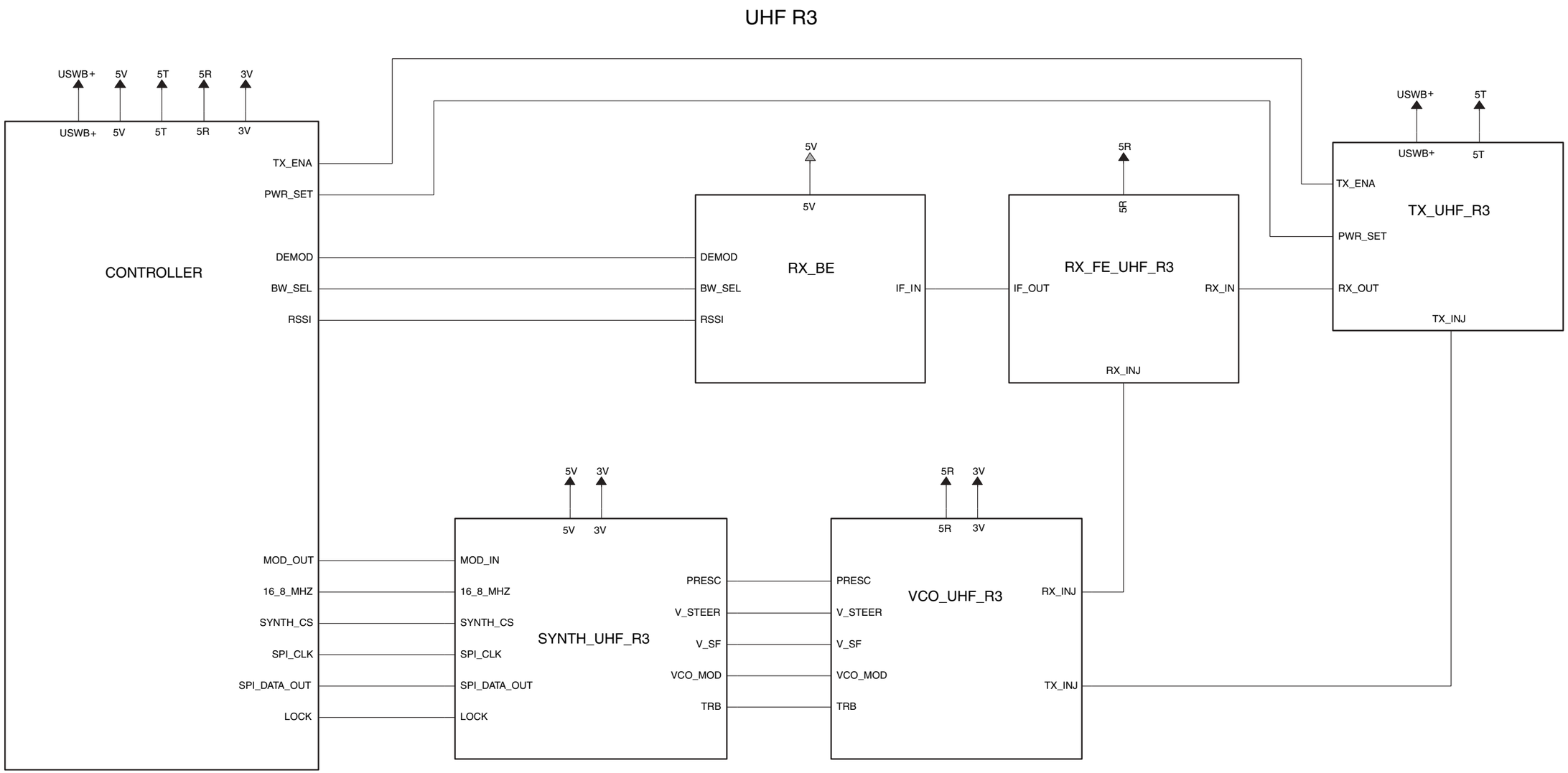


Figure 12-39. UHF (465-495 MHz) Radio Circuit Block Diagram (8486634Z02-O)

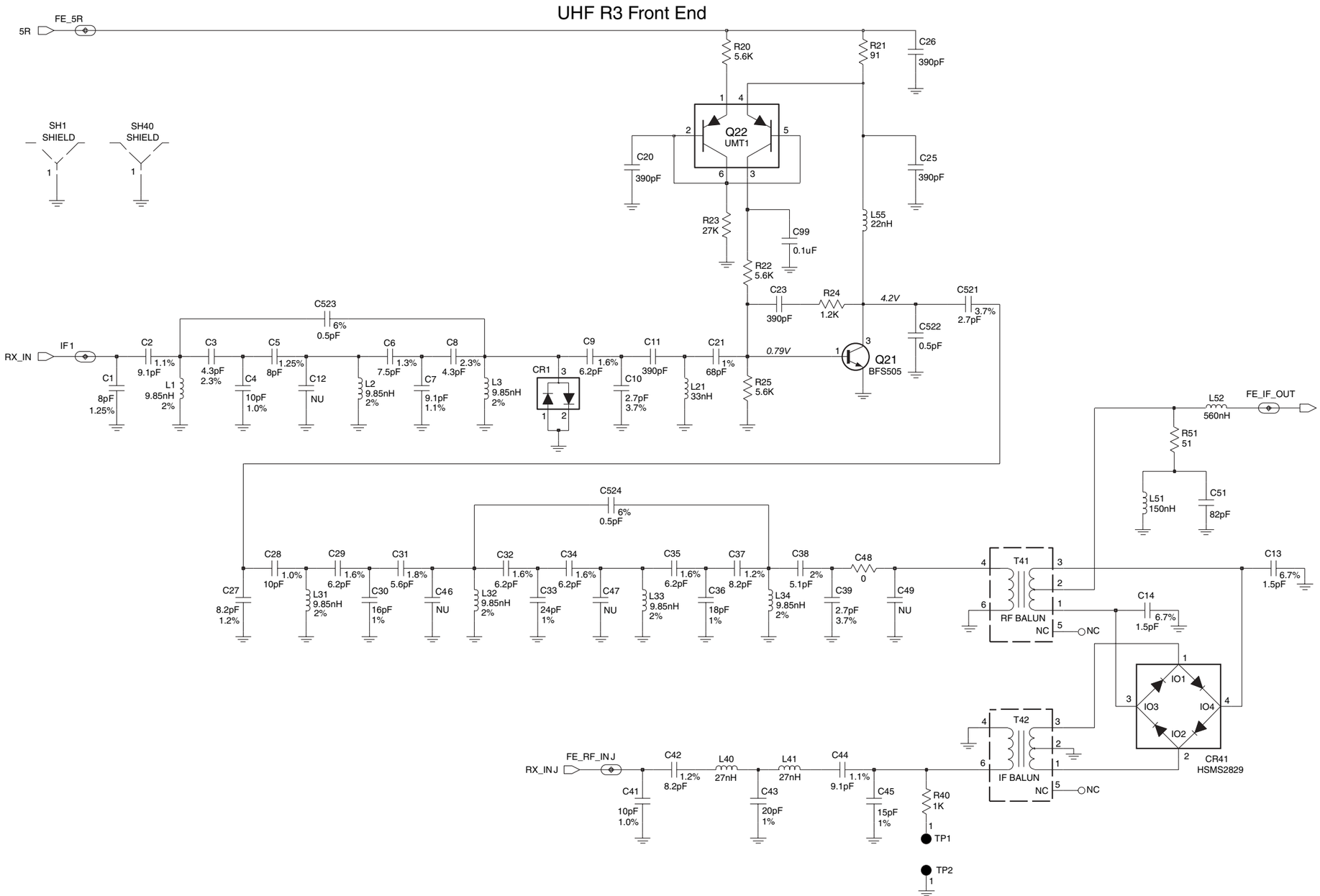


Figure 12-40. UHF (465-495 MHz) Receiver Front End Schematic Diagram (8486634Z02-O)

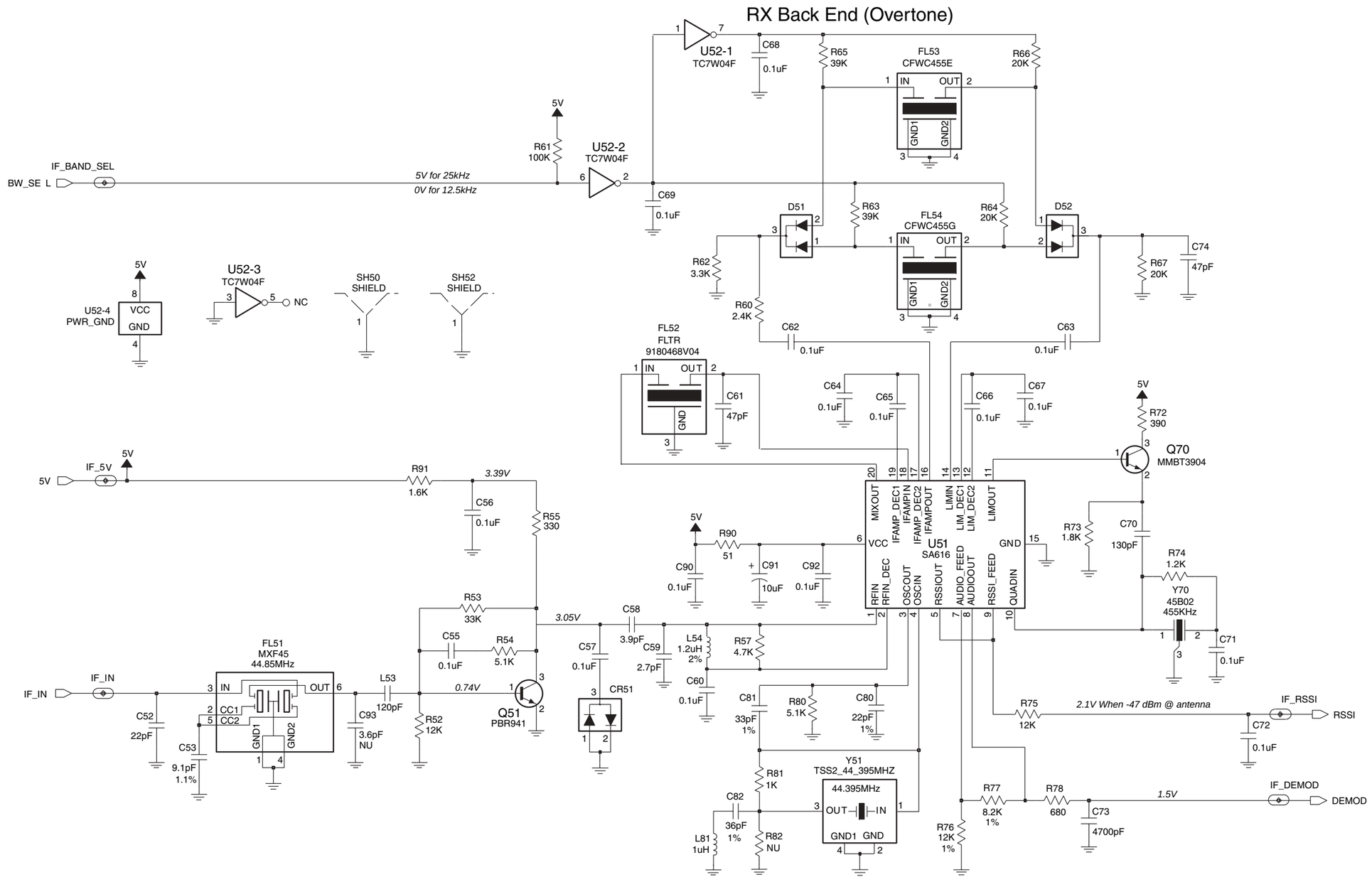
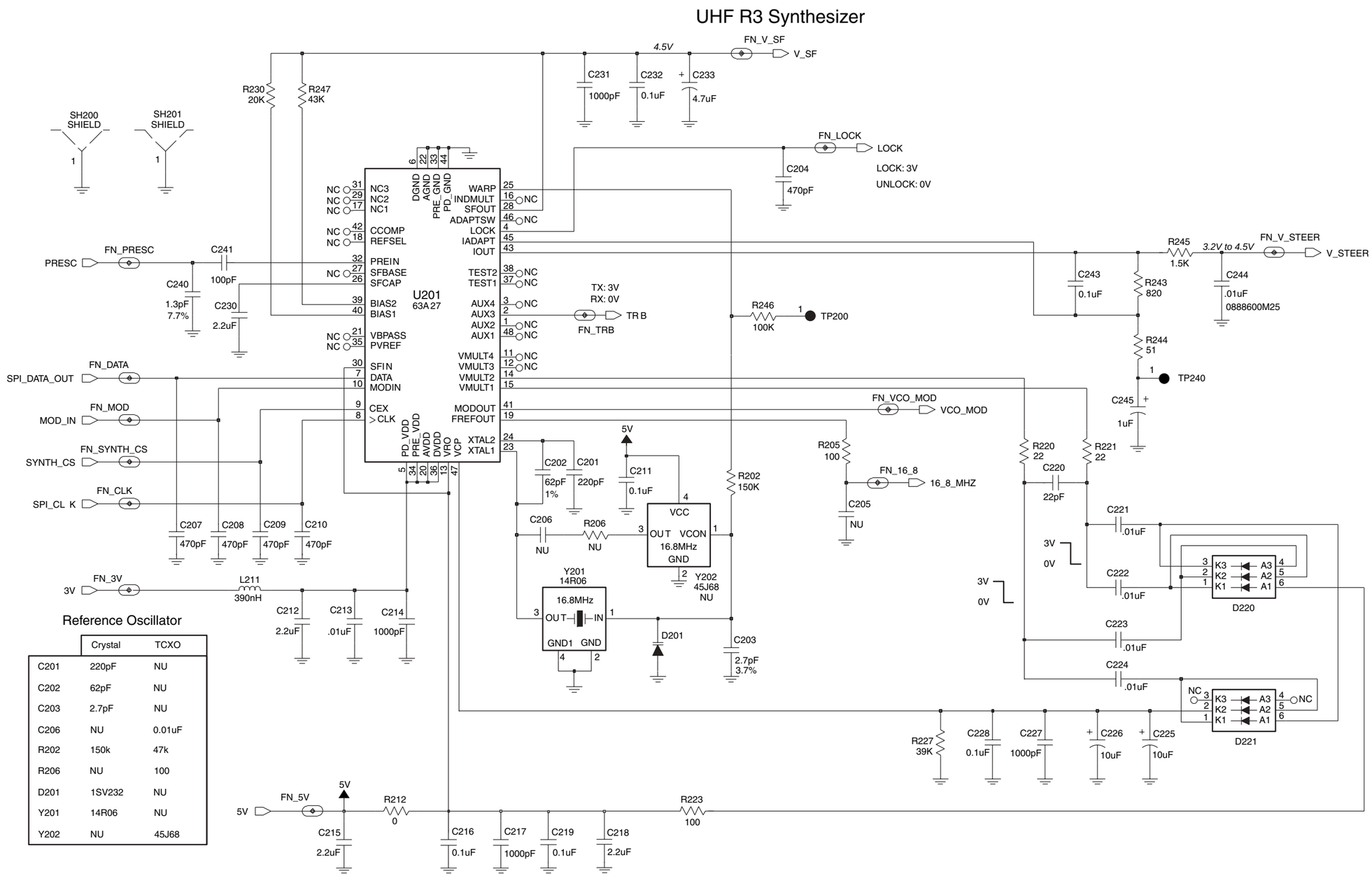


Figure 12-41. UHF (465-495 MHz) Receiver Back End Schematic Diagram (8486634Z02-O)



	Crystal	TCXO
C201	220pF	NU
C202	62pF	NU
C203	2.7pF	NU
C206	NU	0.01uF
R202	150k	47k
R206	NU	100
D201	1SV232	NU
Y201	14R06	NU
Y202	NU	45J68

Figure 12-42. UHF (465-495 MHz) Synthesizer Schematic Diagram (8486634Z02-O)

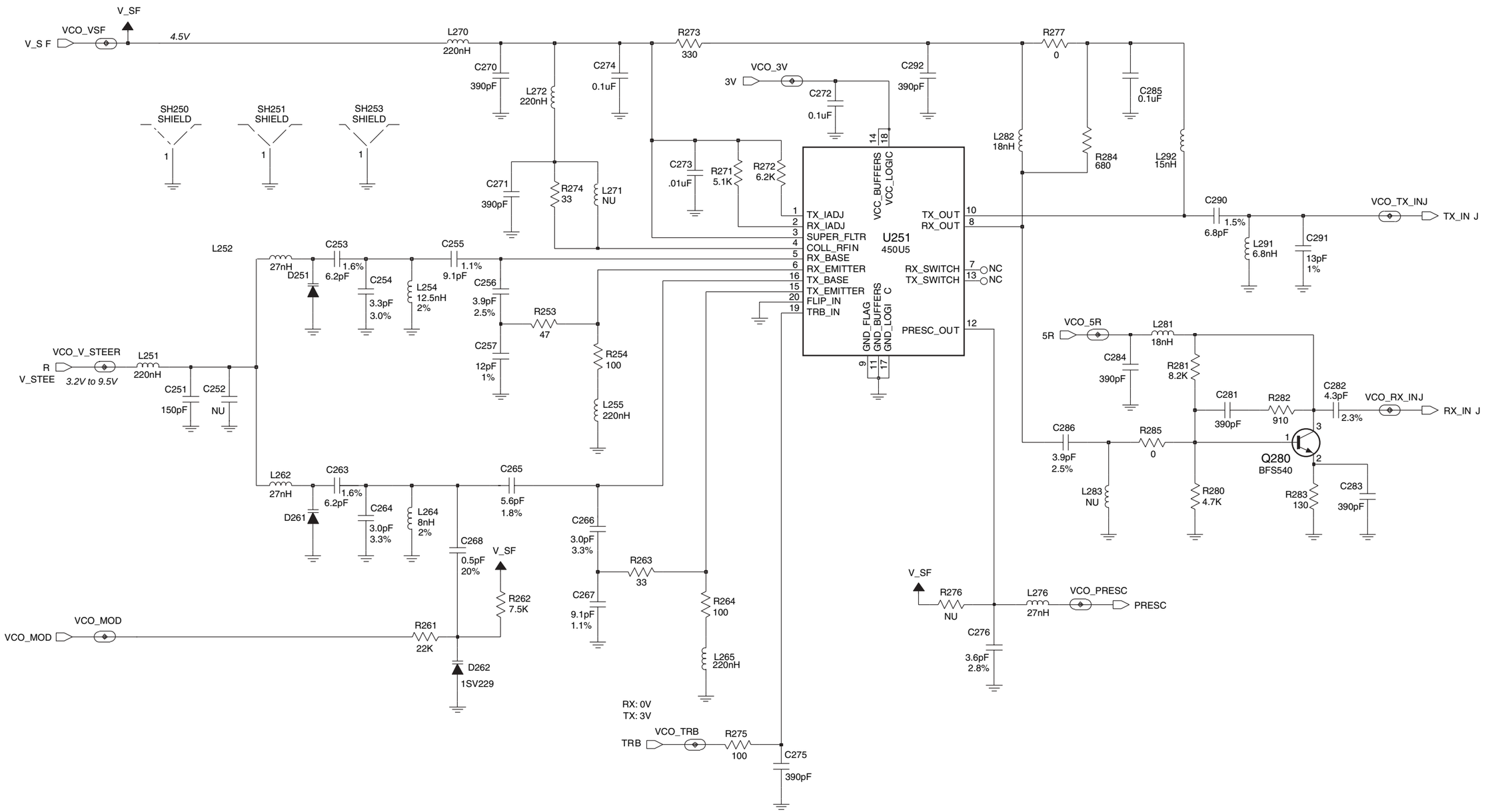


Figure 12-43. UHF (465-495 MHz) Voltage Controlled Oscillator Schematic Diagram (8486634Z02-O)

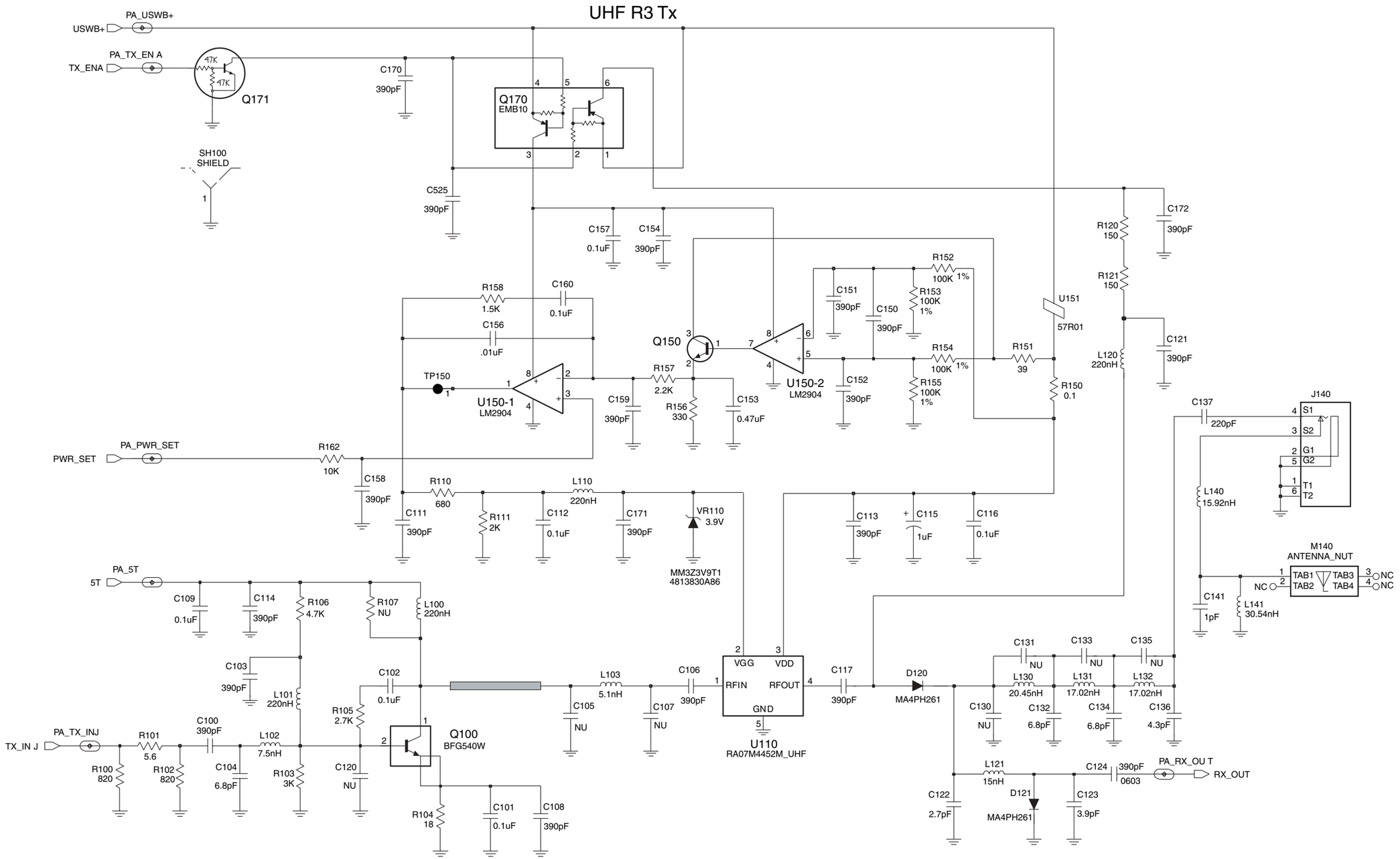


Figure 12-44. UHF (465-495 MHz) Transmitter and Power Control Schematic Diagram (8486634Z02-O)

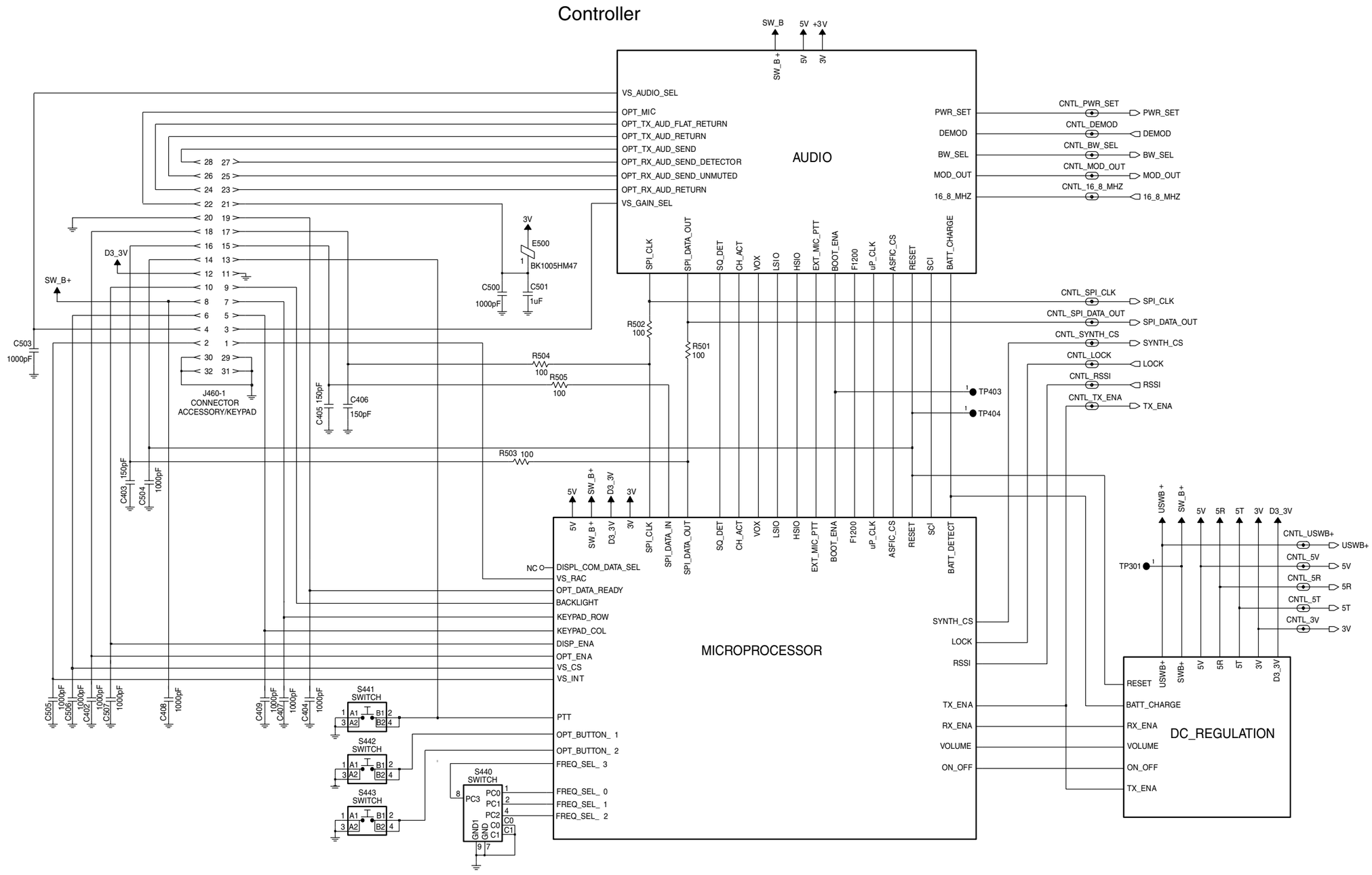


Figure 12-45. UHF (465-495 MHz) Controller Interconnect Schematic Diagram (8486634Z02-O)

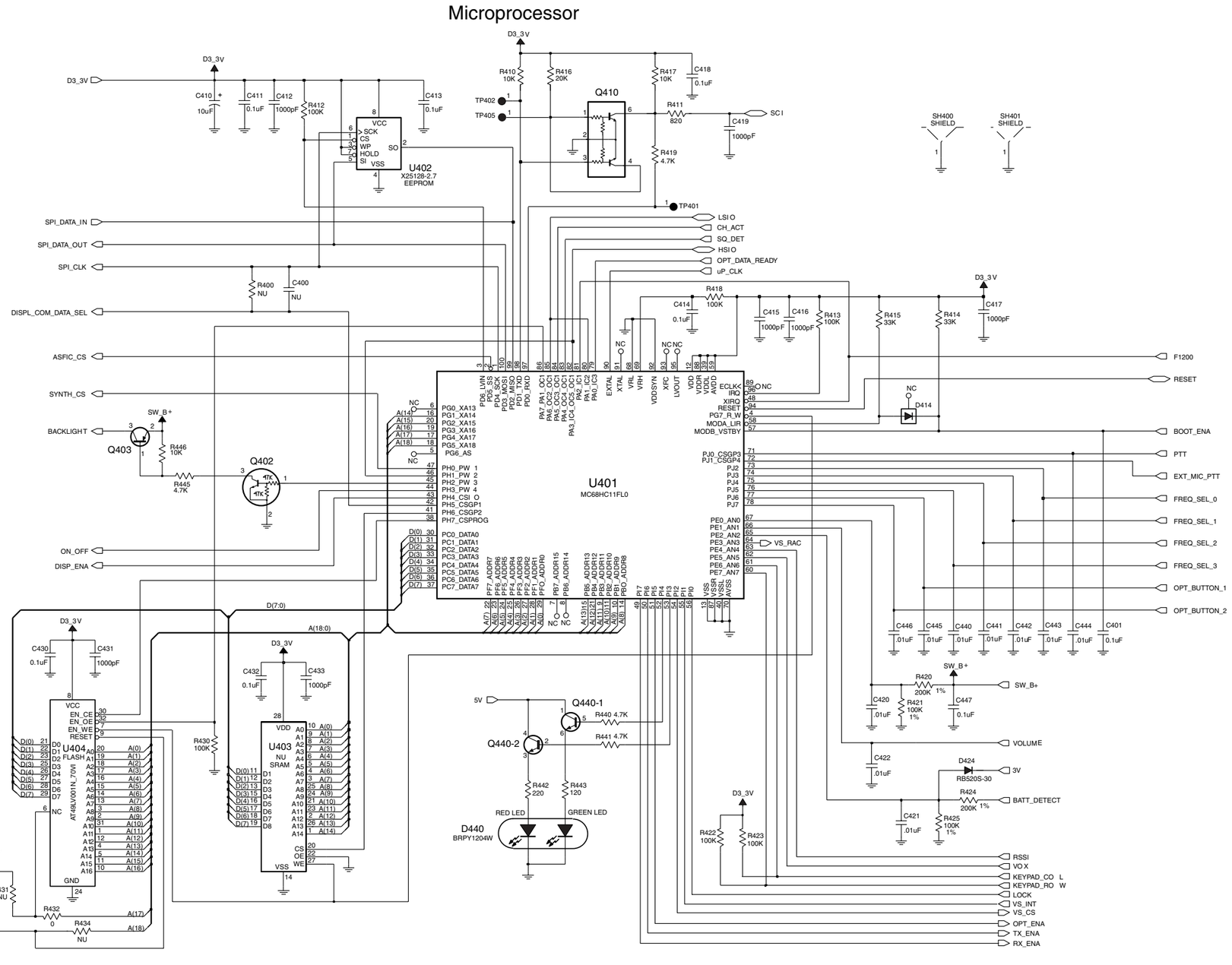
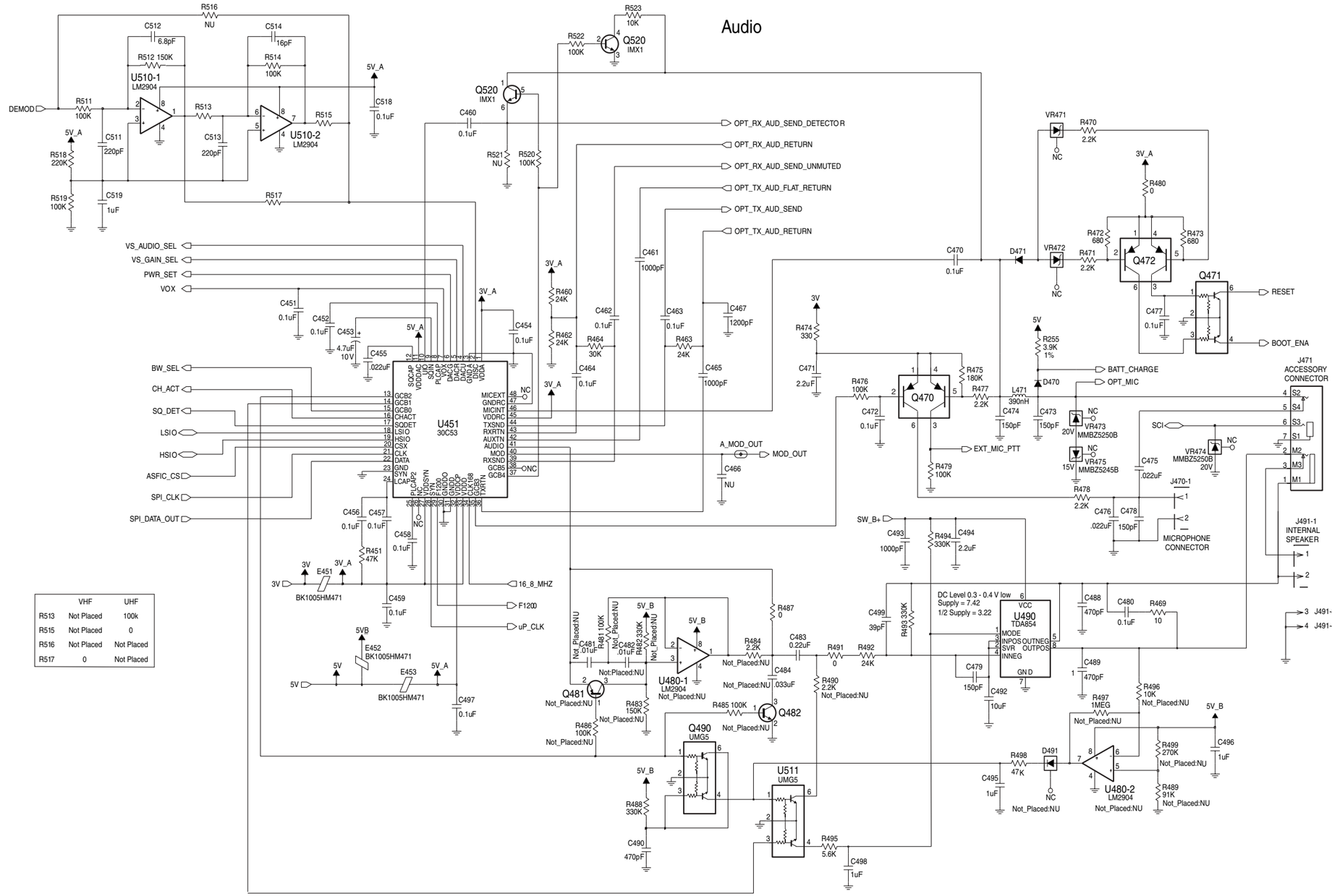


Figure 12-46. UHF (465-495 MHz) Microprocessor Circuitry Schematic Diagram (8486634Z02-O)



	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

Figure 12-47. UHF (465-495 MHz) Audio Circuitry Schematic Diagram (8486634Z02-O)

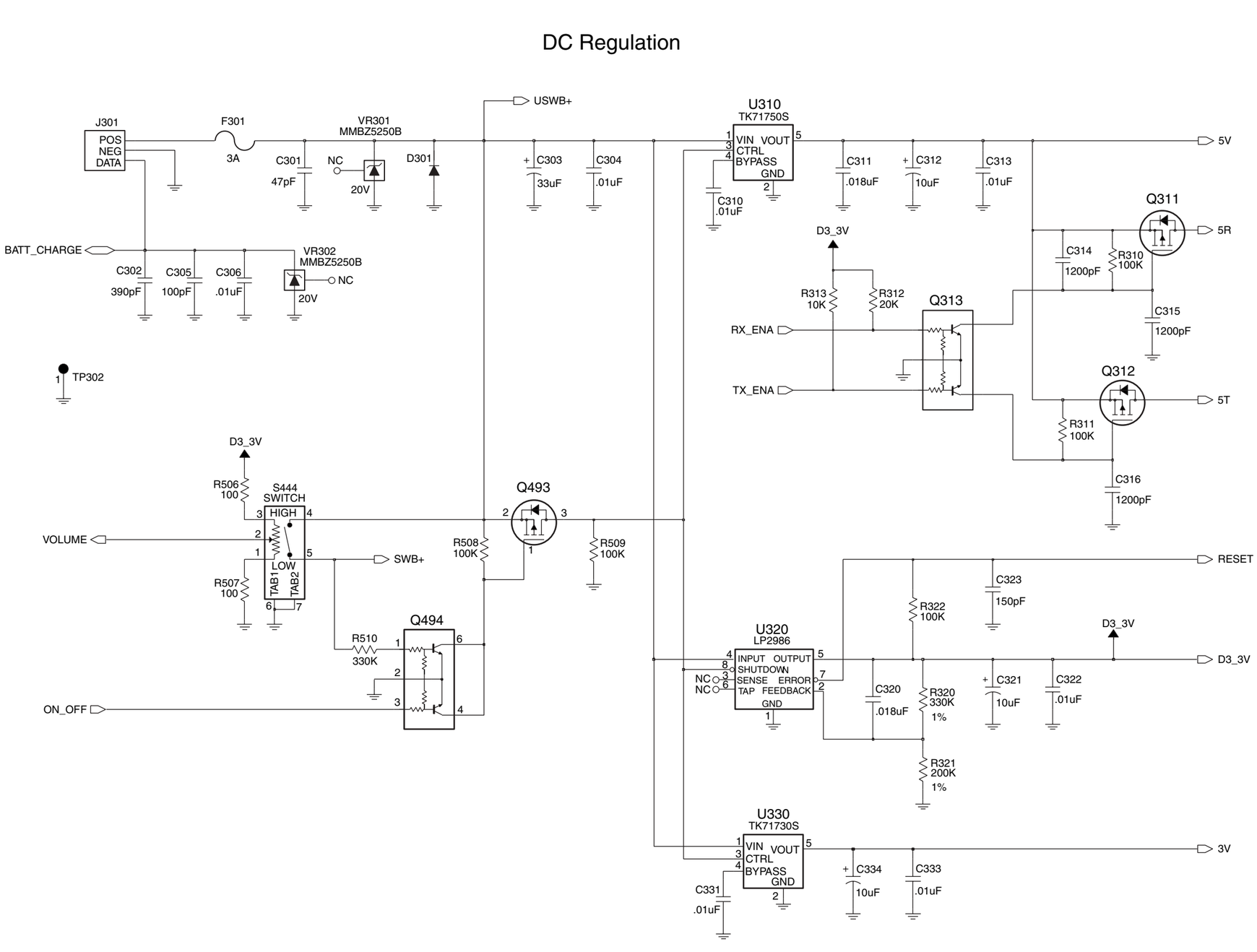


Figure 12-48. UHF (465-495 MHz) DC Regulation Schematic Diagram (8486634Z02-O)

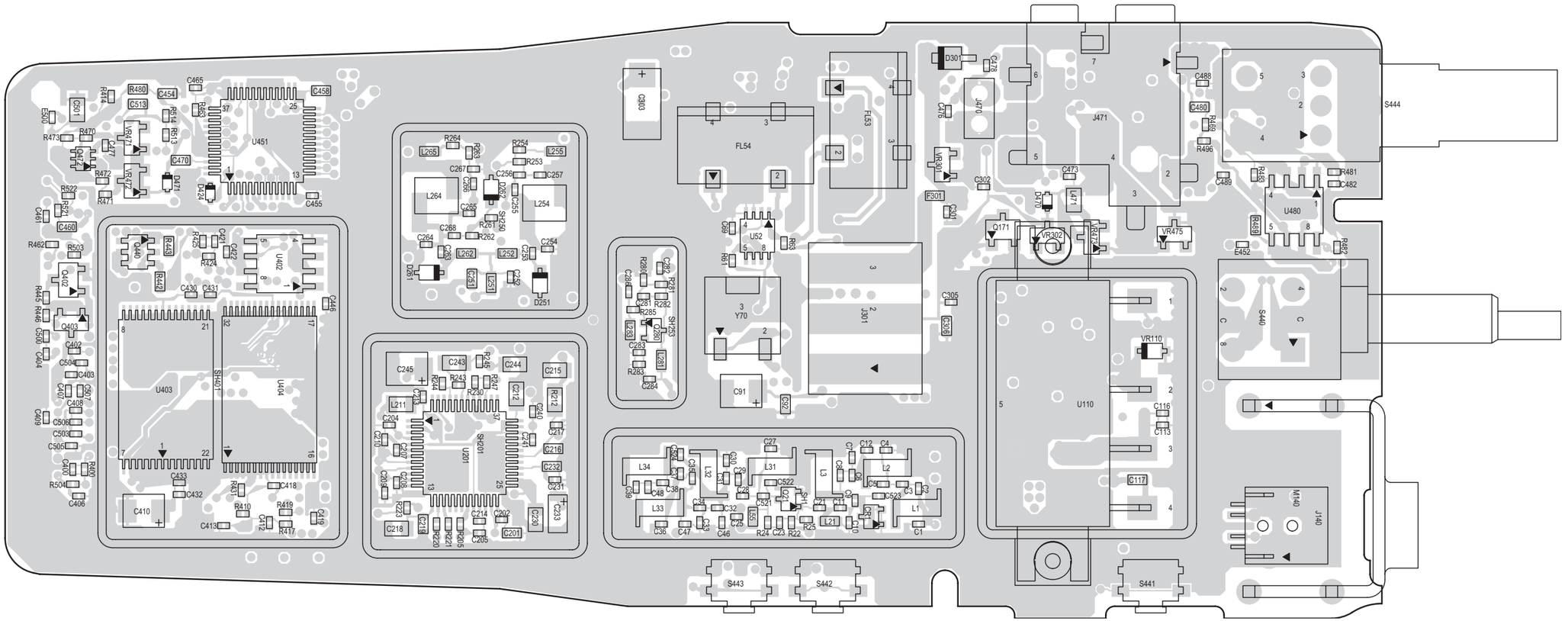


Figure 12-49. UHF (465-495 MHz) Board Component Side View (8486634Z02-O)

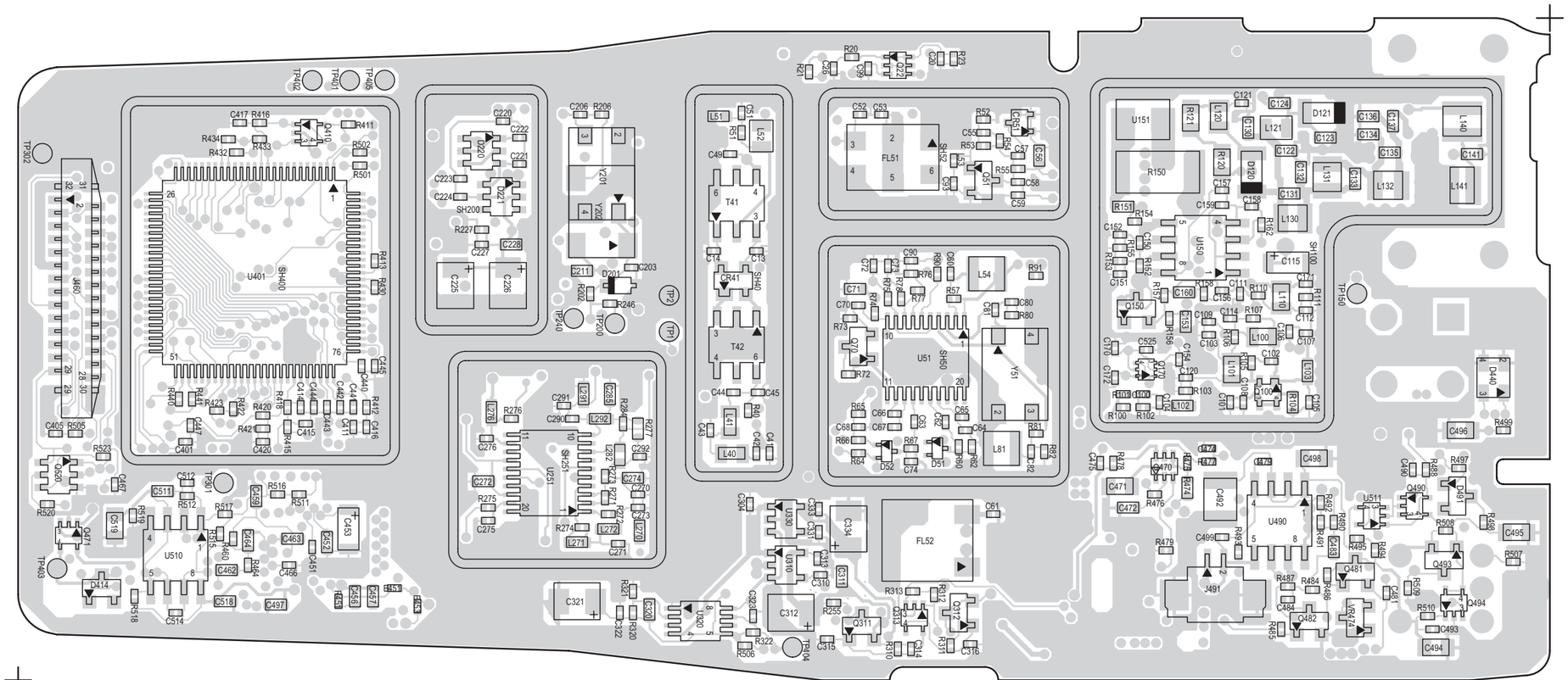


Figure 12-50. UHF (465-495 MHz) Board Solder Side View (8486634Z02-O)

UHF (465-495 MHz) Radio Parts List (8486634Z02-O)

Circuit Ref	Motorola Part No.	Description
C1	2109445U32	CAP, 8pF
C2	2109445U26	CAP, 9.1pF
C3	2109445U18	CAP, 4.3pF
C4	2109445U27	CAP, 10pF
C5	2109445U32	CAP, 8pF
C6	2109445U24	CAP, 7.5pF
C7	2109445U26	CAP, 9.1pF
C8	2109445U18	CAP, 4.3pF
C9	2109445U22	CAP, 6.2pF
C10	2109445U13	CAP, 2.7pF
C11	2113743L07	CAP, 390pF
C12	Not_Placed	CAP, 8.2pF
C13	2109445U07	CAP, 1.5pF
C14	2109445U07	CAP, 1.5pF
C20	2113743L07	CAP, 390pF
C21	2109445U53	CAP, 68pF
C23	2113743L07	CAP, 390pF
C25	2113743L07	CAP, 390pF
C26	2113743L07	CAP, 390pF
C27	2109445U25	CAP, 8.2pF
C28	2109445U27	CAP, 10pF
C29	2109445U22	CAP, 6.2pF
C30	2109445U38	CAP, 16pF
C31	2109445U21	CAP, 5.6pF
C32	2109445U22	CAP, 6.2pF
C33	2109445U42	CAP, 24pF
C34	2109445U22	CAP, 6.2pF
C35	2109445U22	CAP, 6.2pF
C36	2109445U39	CAP, 18pF
C37	2109445U25	CAP, 8.2pF
C38	2109445U20	CAP, 5.1pF
C39	2109445U13	CAP, 2.7pF
C41	2109445U27	CAP, 10pF
C42	2109445U25	CAP, 8.2pF
C43	2109445U40	CAP, 20pF
C44	2109445U26	CAP, 9.1pF
C45	2109445U37	CAP, 15pF
C46	Not_Placed	CAP, 10pF
C47	Not_Placed	CAP, 10pF
C48	0662057M01	RES, 0
C49	Not_Placed	CAP, 3.9pF
C51	2113743N48	CAP, 82pF
C52	2109445U41	CAP, 22pF
C53	2109445U26	CAP, 9.1pF
C55	2113743M24	CAP, 0.1uF
C56	2113743E20	CAP, 0.1uF
C57	2113743M24	CAP, 0.1uF
C58	2113743N16	CAP, 3.9pF
C59	2113743N12	CAP, 2.7pF
C60	2113743M24	CAP, 0.1uF
C61	2113743N46	CAP, 68pF
C62	2113743M24	CAP, 0.1uF
C63	2113743M24	CAP, 0.1uF
C64	2113743M24	CAP, 0.1uF
C65	2113743M24	CAP, 0.1uF
C66	2113743M24	CAP, 0.1uF
C67	2113743M24	CAP, 0.1uF
C68	2113743M24	CAP, 0.1uF
C69	2113743M24	CAP, 0.1uF
C70	2113743N53	CAP, 130pF
C71	2113743E20	CAP, 0.1uF
C72	2113743M24	CAP, 0.1uF
C73	2113743L33	CAP, 4700pF
C74	2113743N42	CAP, 47pF
C80	2109445U41	CAP, 22pF
C81	2109445U45	CAP, 33pF
C82	2109445U46	CAP, 36pF
C90	2113743M24	CAP, 0.1uF
C91	2311049A57	CAPP, 10uF
C92	2113743E20	CAP, 0.1uF
C93	Not_Placed	CAP, 3.6pF
C99	2113743M24	CAP, 0.1uF
C100	2113743L07	CAP, 390pF
C101	2113743M24	CAP, 0.1uF
C102	2113743M24	CAP, 0.1uF
C103	2113743L07	CAP, 390pF
C104	2113743N22	CAP, 6.8pF
C105	Not_Placed	CAP, 3.9pF
C106	2113743L07	CAP, 390pF
C107	Not_Placed	CAP, 27pF
C108	2113743L07	CAP, 390pF
C109	2113743M24	CAP, 0.1uF
C111	2113743L07	CAP, 390pF
C112	2113743M24	CAP, 0.1uF
C113	2113743L07	CAP, 390pF
C114	2113743L07	CAP, 390pF
C115	2311049A07	CAPP, 1uF
C116	2113743M24	CAP, 0.1uF
C117	2113740F65	CAP, 390pF
C120	Not_Placed	CAP, 8.2pF
C121	2113743L07	CAP, 390pF
C122	2113740F13	CAP, 2.7pF
C123	2113740F17	CAP, 3.9pF
C124	2113740F65	CAP, 390pF
C130	Not_Placed	CAP, 3.3pF
C131	Not_Placed	CAP, 2.2pF
C132	2113740F23	CAP, 6.8pF
C133	Not_Placed	CAP, 2.7pF
C134	2113740F23	CAP, 6.8pF
C135	Not_Placed	CAP, 0.5pF
C136	2113740F18	CAP, 4.3pF
C137	2113740F59	CAP, 220pF
C141	2113740F03	CAP, 1pF
C150	2113743L07	CAP, 390pF
C151	2113743L07	CAP, 390pF
C152	2113743L07	CAP, 390pF
C153	2113743K18	CAP, 0.47uF
C154	2113743L07	CAP, 390pF
C156	2113743L41	CAP, .01uF
C157	2113743M24	CAP, 0.1uF
C158	2113743L07	CAP, 390pF
C159	2113743L07	CAP, 390pF
C160	2113743E20	CAP, 0.1uF
C170	2113743L07	CAP, 390pF
C171	2113743L07	CAP, 390pF
C172	2113743L07	CAP, 390pF
C201	2113740F59	CAP, 220pF
C202	2109445U52	CAP, 62pF
C203	2109445U13	CAP, 2.7pF
C204	2113743L09	CAP, 470pF
C205	Not_Placed	CAP, 2.7pF
C206	Not_Placed	CAP, 1000pF
C207	2113743L09	CAP, 470pF
C208	2113743L09	CAP, 470pF
C209	2113743L09	CAP, 470pF
C210	2113743L09	CAP, 470pF
C211	2113743E20	CAP, 0.1uF
C212	2113743F18	CAP, 2.2uF
C213	2113743L41	CAP, .01uF
C214	2113743L17	CAP, 1000pF
C215	2113743F18	CAP, 2.2uF
C216	2113743E20	CAP, 0.1uF
C217	2113743L17	CAP, 1000pF
C218	2113743F18	CAP, 2.2uF
C219	2113743E20	CAP, 0.1uF
C220	2113743N34	CAP, 22pF
C221	2113743L41	CAP, .01uF
C222	2113743L41	CAP, .01uF
C223	2113743L41	CAP, .01uF
C224	2113743L41	CAP, .01uF
C225	2311049A57	CAPP, 10uF
C226	2311049A57	CAPP, 10uF
C227	2113743L17	CAP, 1000pF
C228	2113743E20	CAP, 0.1uF
C230	2113743F18	CAP, 2.2uF
C231	2113743L17	CAP, 1000pF
C232	2113743E20	CAP, 0.1uF
C233	2311049A56	CAPP, 4.7uF
C240	2109445U06	CAP, 1.3pF
C241	2113743N50	CAP, 100pF
C243	0886641Z01	CAP, 0.1uF
C244	0888600M25	CAP, .01uF
C245	2311049A08	CAPP, 1uF
C251	0888600M03	CAP, 150pF
C252	Not_Placed	CAP, 390pF
C253	2109445U22	CAP, 6.2pF
C254	2109445U15	CAP, 3.3pF
C255	2109445U26	CAP, 9.1pF
C256	2109445U17	CAP, 3.9pF
C257	2109445U35	CAP, 12pF
C263	2109445U22	CAP, 6.2pF
C264	2109445U14	CAP, 3.0pF
C265	2109445U21	CAP, 5.6pF
C266	2109445U14	CAP, 3.0pF
C267	2109445U26	CAP, 9.1pF
C268	2109445U01	CAP, 0.5pF
C270	2113743L07	CAP, 390pF
C271	2113743L07	CAP, 390pF
C272	2113743E20	CAP, 0.1uF
C273	2113743L41	CAP, .01uF
C274	2113743E20	CAP, 0.1uF
C275	2113743L07	CAP, 390pF
C276	2109445U16	CAP, 3.6pF
C281	2113743L07	CAP, 390pF
C282	2109445U18	CAP, 4.3pF
C283	2113743L07	CAP, 390pF
C284	2113743L07	CAP, 390pF
C285	2113743E20	CAP, 0.1uF
C286	2109445U17	CAP, 3.9pF
C290	2109445U23	CAP, 6.8pF
C291	2109445U36	CAP, 13pF
C292	2113743L07	CAP, 390pF
C301	2113743N42	CAP, 47pF
C302	2113743L07	CAP, 390pF
C303	2311049A97	CAPP, 33uF
C304	2113743L41	CAP, .01uF
C305	2113743N50	CAP, 100pF
C306	2113741F49	CAP, .01uF
C310	2113743L41	CAP, .01uF
C311	2113743E05	CAP, .018uF
C312	2311049A57	CAPP, 10uF
C313	2113743L41	CAP, .01uF
C314	2113743L19	CAP, 1200pF
C315	2113743L19	CAP, 1200pF
C316	2113743L19	CAP, 1200pF
C320	2113743E05	CAP, .018uF
C321	2311049A57	CAPP, 10uF
C322	2113743L41	CAP, .01uF
C323	2113743N54	CAP, 150pF
C331	2113743L41	CAP, .01uF
C333	2113743L41	CAP, .01uF
C334	2311049A57	CAPP, 10uF
C400	Not_Placed	CAP, .022uF

Circuit Ref	Motorola Part No.	Description
C401	2113743M24	CAP, 0.1uF
C402	2113743L17	CAP, 1000pF
C403	2113743N50	CAP, 150pF
C404	2113743L17	CAP, 1000pF
C405	2113743N50	CAP, 150pF
C406	2113743N50	CAP, 150pF
C407	2113743L17	CAP, 1000pF
C408	2113743L17	CAP, 1000pF
C409	2113743L17	CAP, 1000pF
C410	2311049A57	CAPP, 10uF
C411	2113743M24	CAP, 0.1uF
C412	2113743L17	CAP, 1000pF
C413	2113743M24	CAP, 0.1uF
C414	2113743M24	CAP, 0.1uF
C415	2113743L17	CAP, 1000pF
C416	2113743L17	CAP, 1000pF
C417	2113743L17	CAP, 1000pF
C418	2113743M24	CAP, 0.1uF
C419	2113743L17	CAP, 1000pF
C420	2113743L41	CAP, .01uF
C421	2113743L41	CAP, .01uF
C422	2113743L41	CAP, .01uF
C430	2113743M24	CAP, 0.1uF
C431	2113743L17	CAP, 1000pF
C432	2113743M24	CAP, 0.1uF
C433	2113743L17	CAP, 1000pF
C440	2113743L41	CAP, .01uF
C441	2113743L41	CAP, .01uF
C442	2113743L41	CAP, .01uF
C443	2113743L41	CAP, .01uF
C444	2113743L41	CAP, .01uF
C445	2113743L41	CAP, .01uF
C446	2113743L41	CAP, .01uF
C447	2113743M24	CAP, 0.1uF
C451	2113743M24	CAP, 0.1uF
C452	2113743E20	CAP, 0.1uF
C453	2311049A56	CAPP, 4.7uF
C454	2113743E20	CAP, 0.1uF
C455	2113743L48	CAP, .022uF
C456	2113743E20	CAP, 0.1uF
C457	2113743E20	CAP, 0.1uF
C458	2113743E20	CAP, 0.1uF
C459	2113743E20	CAP, 0.1uF
C460	2113743E20	CAP, 0.1uF
C461	2113743L17	CAP, 1000pF
C462	2113743E20	CAP, 0.1uF
C463	2113743E20	CAP, 0.1uF
C464	2113743E20	CAP, 0.1uF
C465	2113743L17	CAP, 1000pF
C466	Not_Placed	CAP, 470pF
C467	2113743L19	CAP, 1200pF
C470	2113743E20	CAP, 0.1uF
C471	2113743F18	CAP, 2.2uF
C472	2113743E20	CAP, 0.1uF
C473	2113743N54	CAP, 150pF
C474	2113743N54	CAP, 150pF
C475	2113743L48	CAP, .022uF
C476	2113743L48	CAP, .022uF
C477	2113743M24	CAP, 0.1uF
C478	2113743N54	CAP, 150pF
C479	2113743N54	CAP, 150pF
C480	2113743E20	CAP, 0.1uF
C481	Not_Placed	CAP, .01uF
C482	Not_Placed	CAP, .01uF
C483	2113928H02	CAP, 0.22uF
C484	Not_Placed	CAP, .033uF
C488	2113743L09	CAP, 470pF
C489	2113743L09	CAP, 470pF
C490	2113743L09	CAP, 470pF
C492	2113928J08	CAP, 10uF
C493	2113743L17	CAP, 1000pF
C494	2113743F18	CAP, 2.2uF
C495	2113743F16	CAP, 1uF
C496	2113743F16	CAP, 1uF
C497	2113743E20	CAP, 0.1uF
C498	2113743F16	CAP, 1uF
C499	2113743N40	CAP, 39pF
C500	2113743L17	CAP, 1000pF
C501	2113743F16	CAP, 1uF
C503	2113743L17	CAP, 1000pF
C504	2113743L17	CAP, 1000pF
C505	2113743L17	CAP, 1000pF
C506	2113743L17	CAP, 1000pF
C507	2113743L17	CAP, 1000pF
C511	2113740F59	CAP, 220pF
C512	2113743N22	CAP, 6.8pF
C513	2113740F59	CAP, 220pF
C514	2113743N31	CAP, 16pF
C518	2113743E20	CAP, 0.1uF
C519	2113743F16	CAP, 1uF
C521	2109445U13	CAP, 2.7pF
C522	2113743N01	CAP, 0.5pF
C523	2186463Z03	CAP, 0.5pF
C524	2186463Z03	CAP, 0.5pF
C525	2113743L07	CAP, 390pF
CR1	4813825A19	MMBD352
CR41	4802246J04	HSMS2829
CR51	4813825A19	MMBD352
D51	4802245J97	DAN235ETL
D52	4802245J97	DAN235ETL
D120	4880973Z02	MA4PH261
D121	4880973Z02	MA4PH261
D201	4862824C03	1SV232
D220	4802233J09	IMN10
D221	4802233J09	IMN10
D251	4862824C01	1SV229
D261	4862824C01	1SV229
D262	4862824C01	1SV229
D301	4813833A19	MBRM120ET3
D414	4805129M41	MMBD501
D424	4809924D18	RB520S-30
D440	4805729G49	BRPY1204W
D470	4809924D18	RB520S-30
D471	4809924D18	RB520S-30
D491	Not_Placed	MMBD501
E451	2480640Z01	BK1005HM471
E452	2480640Z01	BK1005HM471
E453	2480640Z01	BK1005HM471
E500	2480640Z01	BK1005HM471
F301	6580542Z01	FUSE
FL51	9180022M11	MXF45
FL52	9180468V04	FLTR
FL53	9180469V05	CFWC455E
FL54	9180469V03	CFWC455G
J140	0986428Z01	CONN_J
J301	0986565Z01	CONN_J
J460	Not_Placed	CONN_J
J470	0985818A01	CONN_J
J471	0980683Z03	CONN_J
J491	2809926G01	CONN_P
L1	2409348J15	IDCTR, 9.85nH
L2	2409348J15	IDCTR, 9.85nH
L3	2409348J15	IDCTR, 9.85nH
L21	2413926N18	IDCTR, 33nH
L31	2409348J15	IDCTR, 9.85nH
L32	2409348J15	IDCTR, 9.85nH
L33	2409348J15	IDCTR, 9.85nH
L34	2409348J15	IDCTR, 9.85nH
L40	2413926K16	IDCTR, 27nH
L41	2413926K16	IDCTR, 27nH
L51	2413926N26	IDCTR, 150nH
L52	2462587V43	IDCTR, 560nH
L53	2113743N52	CAP, 120pF
L54	2413923A25	IDCTR, 1.2uH
L55	2413926N16	IDCTR, 22nH
L81	2413923A19	IDCTR, 1uH
L100	2413926K27	IDCTR, 220nH
L101	2413926K27	IDCTR, 220nH
L102	2409377M25	IDCTR, 7.5nH
L103	2409377M24	IDCTR, 5.1nH
L110	2413926K27	IDCTR, 220nH
L120	2413926K27	IDCTR, 220nH
L121	2462587V24	IDCTR, 15nH
L130	2460591C36	IDCTR, 20.45nH
L131	2460591C40	IDCTR, 17.02nH
L132	2460591C40	IDCTR, 17.02nH
L140	2460591L14	IDCTR, 15.92nH
L141	2479990M01	IDCTR, 30.54nH
L211	2413926K30	IDCTR, 390nH
L251	2413926N28	IDCTR, 220nH
L252	2413926N17	IDCTR, 27nH
L254	2484562T11	IDCTR, 12.5nH
L255	2413926N28	IDCTR, 220nH
L262	2413926N17	IDCTR, 27nH
L264	2484562T13	IDCTR, 8nH
L265	2413926N28	IDCTR, 220nH
L270	2413926N28	IDCTR, 220nH
L271	Not_Placed	IDCTR, 220nH
L272	2413926N28	IDCTR, 220nH
L276	2413926N17	IDCTR, 27nH
L281	2413926N15	IDCTR, 18nH
L282	2413926N15	IDCTR, 18nH
L283	Not_Placed	IDCTR, 22nH
L291	2413926N10	IDCTR, 6.8nH
L292	2413926N14	IDCTR, 15nH
L471	2413926K30	IDCTR, 390nH
M140	0286427Z01	ANTENNA_NUT
Q21	4802247J01	BFS505
Q22	4805723X02	UMT1
Q51	4802197J95	PBR941
Q70	4880214G02	MMBT3904
Q100	4885593U03	BFG540W
Q150	4880214G02	MMBT3904
Q170	4809939C34	EMB10
Q171	4880048M01	DTC144EKA
Q280	4802245J95	BFS540
Q311	4809579E18	TP0101T
Q312	4809579E18	TP0101T
Q313	4802245J54	UMG5
Q402	4880048M01	DTC144EKA
Q403	4813824A17	MMBT3906
Q410	4802245J54	UMG5
Q440	5180159R01	IMX1
Q470	4805723X02	UMT1
Q471	4802245J54	UMG5
Q472	4805723X02	UMT1
Q481	Not_Placed	MMBT3906
Q482	Not_Placed	MMBT3904
Q490	4802245J54	UMG5
Q493	4809579E18	TP0101T
Q494	4802245J54	UMG5
Q520	5180159R01	IMX1
R20	0662057M92	RES, 5.6K
R21	0662057M49	RES, 91

Circuit Ref	Motorola Part No.	Description
R22	0662057M92	RES, 5.6K
R23	0662057N09	RES, 27K
R24	0662057M76	RES, 1.2K
R25	0662057M92	RES, 5.6K
R40	0662057M74	RES, 1K
R51	0662057M43	RES, 51
R52	0662057N01	RES, 12K
R53	0662057N11	RES, 33K
R54	0662057M91	RES, 5.1K
R55	0662057M62	RES, 330
R57	0662057M90	RES, 4.7K
R60	0662057M83	RES, 2.4K
R61	0662057N23	RES, 100K
R62	0662057M86	RES, 3.3K
R63	0662057N13	RES, 39K
R64	0662057N06	RES, 20K
R65	0662057N13	RES, 39K
R66	0662057N06	RES, 20K
R67	0662057N06	RES, 20K
R72	0662057M64	RES, 390
R73	0662057M80	RES, 1.8K
R74	0662057M76	RES, 1.2K
R75	0662057N01	RES, 12K
R76	0662057V04	RES, 12K
R77	0662057U99	RES, 8.2K
R78	0662057M70	RES, 680
R80	0662057M91	RES, 5.1K
R81	0662057M74	RES, 1K
R82	Not_Placed	RES, 0
R90	0662057M43	RES, 51
R91	0662057M79	RES, 1.6K
R100	0662057M72	RES, 820
R101	0662057M20	RES, 5.6
R102	0662057M72	RES, 820
R103	0662057M85	RES, 3K
R104	0662057A07	RES, 18
R105	0662057M84	RES, 2.7K
R106	0662057M90	RES, 4.7K
R107	Not_Placed	RES, 300
R110	0662057M70	RES, 680
R111	0662057M81	RES, 2K
R120	0662057C55	RES, 150
R121	0662057C55	RES, 150
R150	0680539Z01	RES, 0.1
R151	0662057A15	RES, 39
R152	0662057V27	RES, 100K
R153	0662057V27	RES, 100K
R154	0662057V27	RES, 100K
R155	0662057V27	RES, 100K
R156	0662057M62	RES, 330
R157	0662057M82	RES, 2.2K
R158	0662057M78	RES, 1.5K
R162	0662057M98	RES, 10K
R202	0662057N27	RES, 150K
R205	0662057M50	RES, 100
R206	Not_Placed	RES, 100
R212	0662057C01	RES, 0
R220	0662057M34	RES, 22
R221	0662057M34	RES, 22
R223	0662057M50	RES, 100
R227	0662057N13	RES, 39K
R230	0662057N06	RES, 20K
R243	0662057M72	RES, 820
R244	0662057M43	RES, 51
R245	0662057M78	RES, 1.5K
R246	0662057N23	RES, 100K
R247	0662057N14	RES, 43K
R253	0662057M42	RES, 47
R254	0662057M50	RES, 100
R255	0662057U91	RES, 3.9K
R261	0662057N07	RES, 22K
R262	0662057M95	RES, 7.5K
R263	0662057M38	RES, 33
R264	0662057M50	RES, 100
R271	0662057M91	RES, 5.1K
R272	0662057M93	RES, 6.2K
R273	0662057M62	RES, 330
R274	0662057M38	RES, 33
R275	0662057M50	RES, 100
R276	Not_Placed	RES, 1K
R277	0662057B47	RES, 0
R280	0662057M90	RES, 4.7K
R281	0662057M96	RES, 8.2K
R282	0662057M73	RES, 910
R283	0662057M53	RES, 130
R284	0662057M70	RES, 680
R285	0662057M01	RES, 0
R310	0662057N23	RES, 100K
R311	0662057N23	RES, 100K
R312	0662057N06	RES, 20K
R313	0662057M98	RES, 10K
R320	0662057V43	RES, 330K
R321	0662057V35	RES, 200K
R322	0662057N23	RES, 100K
R400	Not_Placed	RES, 100K
R410	0662057M98	RES, 10K
R411	0662057M72	RES, 820
R412	0662057N23	RES, 100K
R413	0662057N23	RES, 100K
R414	0662057N11	RES, 33K
R415	0662057N11	RES, 33K
R416	0662057N06	RES, 20K
R417	0662057M98	RES, 10K
R418	0662057N23	RES, 100K
R419	0662057M90	RES, 4.7K
R420	0662057V35	RES, 200K
R421	0662057V27	RES, 100K
R422	0662057N23	RES, 100K
R423	0662057N23	RES, 100K
R424	0662057V35	RES, 200K
R425	0662057V27	RES, 100K
R430	0662057N23	RES, 100K
R431	Not_Placed	RES, 100K
R432	0662057M01	RES, 0
R433	0662057N23	RES, 100K
R434	Not_Placed	RES, 100K
R440	0662057M90	RES, 4.7K
R441	0662057M90	RES, 4.7K
R442	0662057A33	RES, 220
R443	0662057A27	RES, 120
R445	0662057M90	RES, 4.7K
R446	0662057M98	RES, 10K
R451	0662057N15	RES, 47K
R460	0662057N08	RES, 24K
R462	0662057N08	RES, 24K
R463	0662057N08	RES, 24K
R464	0662057N10	RES, 30K
R469	0662057M26	RES, 10
R470	0662057M82	RES, 2.2K
R471	0662057M82	RES, 2.2K
R472	0662057M70	RES, 680
R473	0662057M70	RES, 680
R474	0662057A37	RES, 330
R475	0662057N29	RES, 180K
R476	0662057N23	RES, 100K
R477	0662057M82	RES, 2.2K
R478	0662057M82	RES, 2.2K
R479	0662057N23	RES, 100K
R480	0662057B47	RES, 0
R481	Not_Placed	RES, 100K
R482	Not_Placed	RES, 330K
R483	Not_Placed	RES, 150K
R484	Not_Placed	RES, 2.2K
R485	Not_Placed	RES, 100K
R486	Not_Placed	RES, 100K
R487	0662057M01	RES, 0
R488	0662057N35	RES, 330K
R489	Not_Placed	RES, 91K
R490	Not_Placed	RES, 2.2K
R491	0662057M01	RES, 0
R492	0662057N08	RES, 24K
R493	0662057N35	RES, 330K
R494	0662057V43	RES, 330K
R495	0662057M92	RES, 5.6K
R496	Not_Placed	RES, 10K
R497	Not_Placed	RES, 1MEG
R498	Not_Placed	RES, 47K
R499	Not_Placed	RES, 270K
R501	0662057M50	RES, 100
R502	0662057M50	RES, 100
R503	0662057M50	RES, 100
R504	0662057M50	RES, 100
R505	0662057M50	RES, 100
R506	0662057M50	RES, 100
R507	0662057M50	RES, 100
R508	0662057N23	RES, 100K
R509	0662057N23	RES, 100K
R510	0662057N35	RES, 330K
R511	0662057N23	RES, 100K
R512	0662057N27	RES, 150K
R513	0662057N23	RES, 100K
R514	0662057N23	RES, 100K
R515	0662057M01	RES, 0
R516	Not_Placed	RES, 0
R517	Not_Placed	RES, 0
R518	0662057N31	RES, 220K
R519	0662057N23	RES, 100K
R520	0662057N23	RES, 100K
R521	Not_Placed	RES, 100K
R522	0662057N23	RES, 100K
R523	0662057M98	RES, 10K
S440	4080710Z22	switch, rotary 16-channel select
	or 4080710Z13	switch, rotary 4-channel select
S441	4070354A01	SWITCH
S442	4070354A01	SWITCH
S443	4070354A01	SWITCH
S444	1880619Z02	SWITCH
SH1	2686421Z01	SHIELD
SH40	2686419Z01	SHIELD
SH50	2686423Z01	SHIELD
SH52	2686424Z01	SHIELD
SH100	2686418Z01	SHIELD
SH200	2686424Z01	SHIELD
SH201	2686423Z01	SHIELD
SH250	2686425Z01	SHIELD
SH251	2686425Z01	SHIELD
SH253	2686422Z01	SHIELD
SH400	2686420Z01	SHIELD
SH401	2686420Z01	SHIELD
T41	2580541Z02	XFMR
T42	2580541Z02	XFMR
U51	5186144B01	SA616

Circuit Ref	Motorola Part No.	Description
U52	5109522E10	TC7W04F
U110	0186438Z02	RA07M4452M_UHF
U150	5113818A01	LM2904
U151	2484657R01	57R01
U201*	5185963A27	63A27
U251	5105750U54	50U54
U310	5102478J01	TK71750S
U320	5185963A55	LP2986
U330	5102479J01	TK71730S
U401*	5102226J56	MC68HC11FL0
U402*	5102463J64	X25128-2.7
U403	Not_Placed	SRM2B256
U404*	5102480J01	AT49LV001N_70VI
U451	5185130C53	30C53
U480	Not_Placed	LM2904
U490	5108858K99	TDA8541
U510	5113818A01	LM2904
U511	4802245J54	UMG5
VR110	4813830A86	MM3Z3V9T1
VR301	4813830A33	MMBZ5250B
VR302	4813830A33	MMBZ5250B
VR471	4813830A18	MMBZ5235B
VR472	4813830A09	MMBZ5226B
VR473	4813830A33	MMBZ5250B
VR474	4813830A33	MMBZ5250B
VR475	4880140L20	MMBZ5245B
Y51	4802245J84	TSS2_44_395MHZ
Y70	9186145B02	45B02
Y201*	4880114R06	14R06
Y202	Not_Placed	45J68

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